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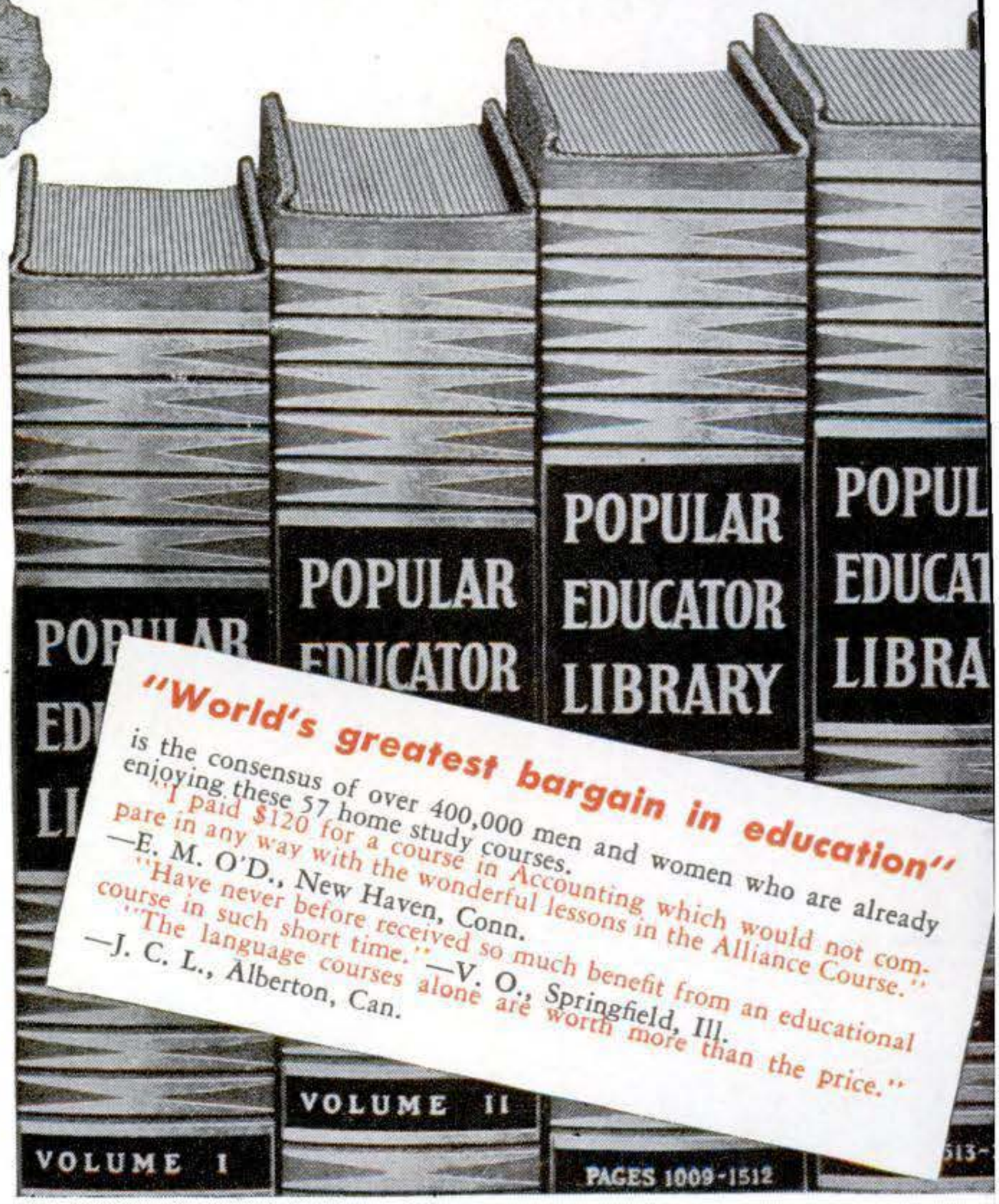

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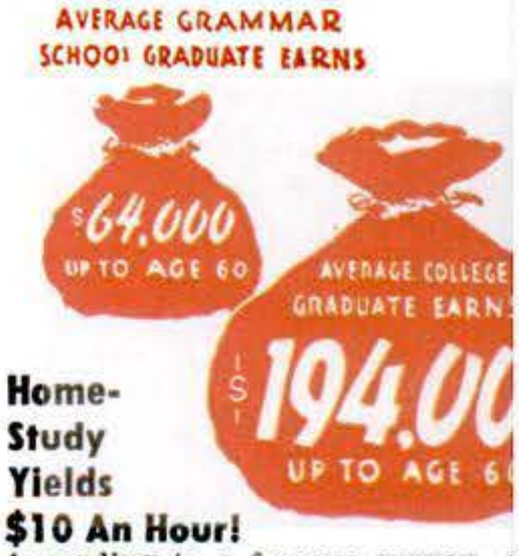

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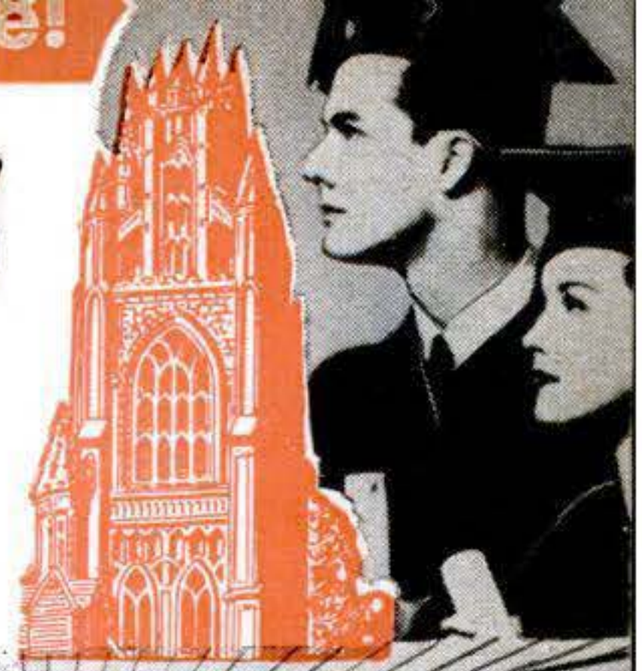

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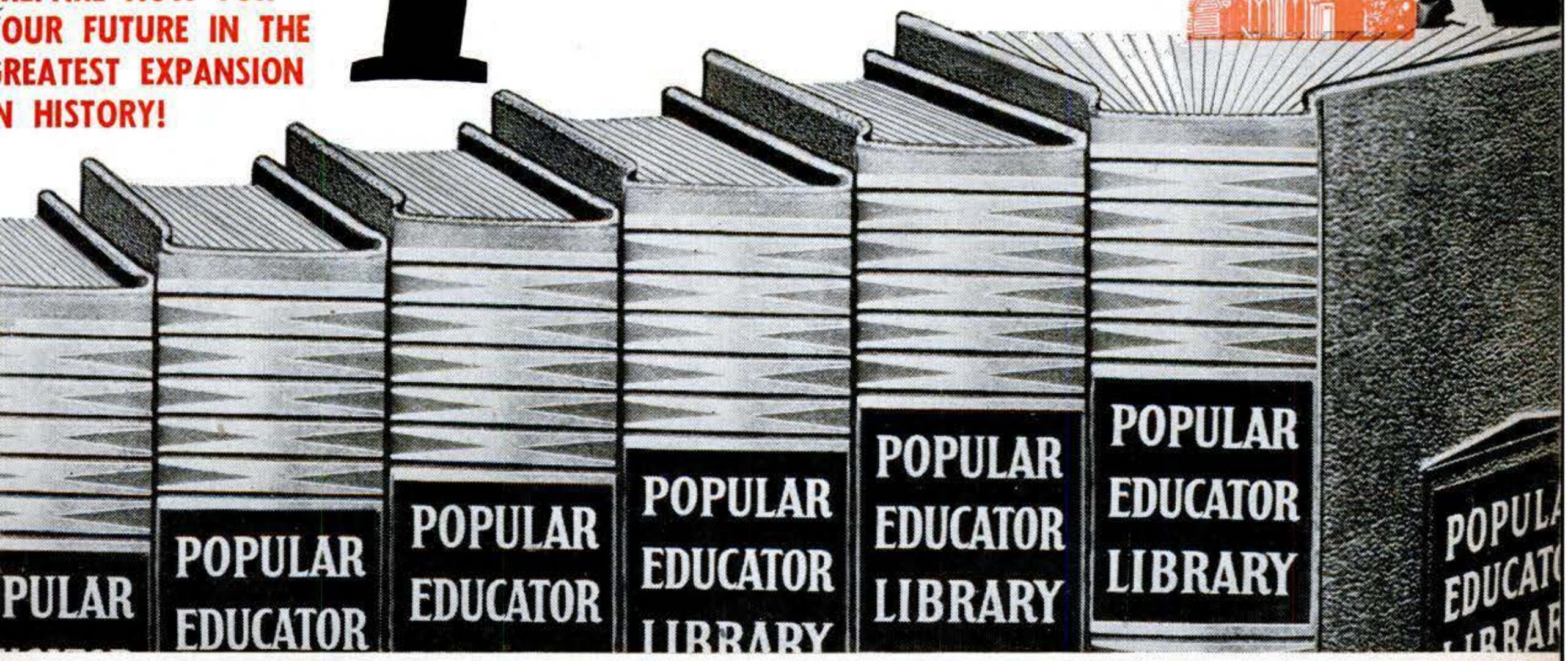

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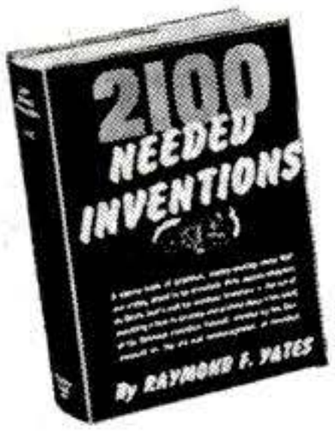

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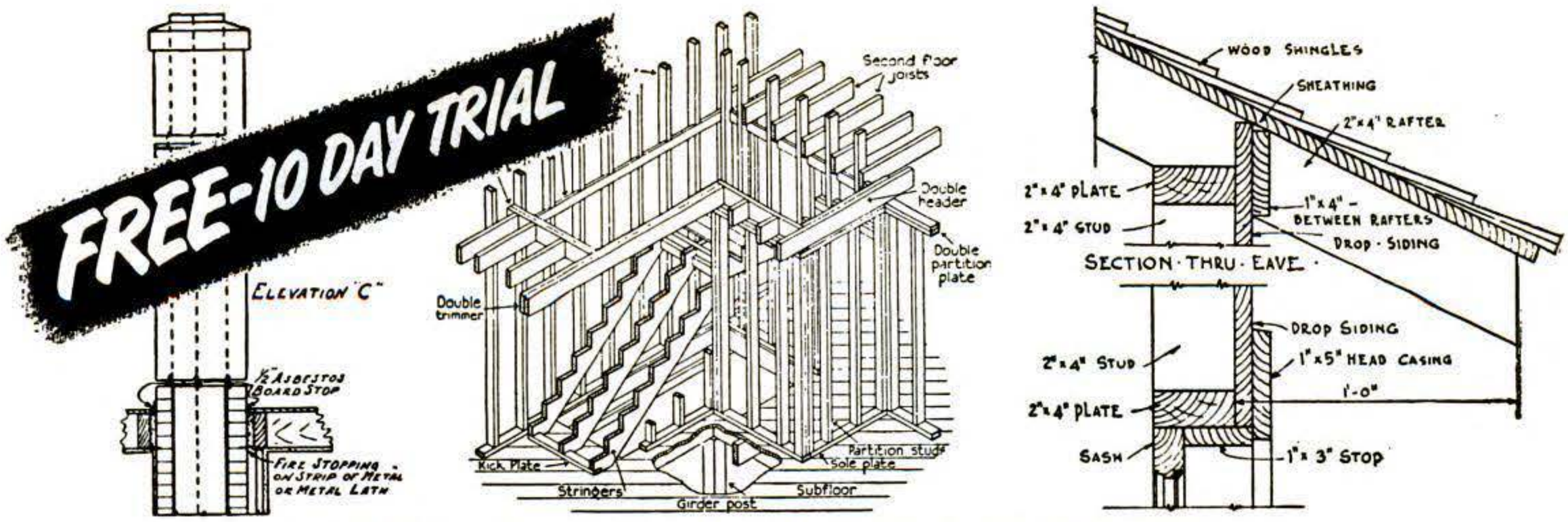

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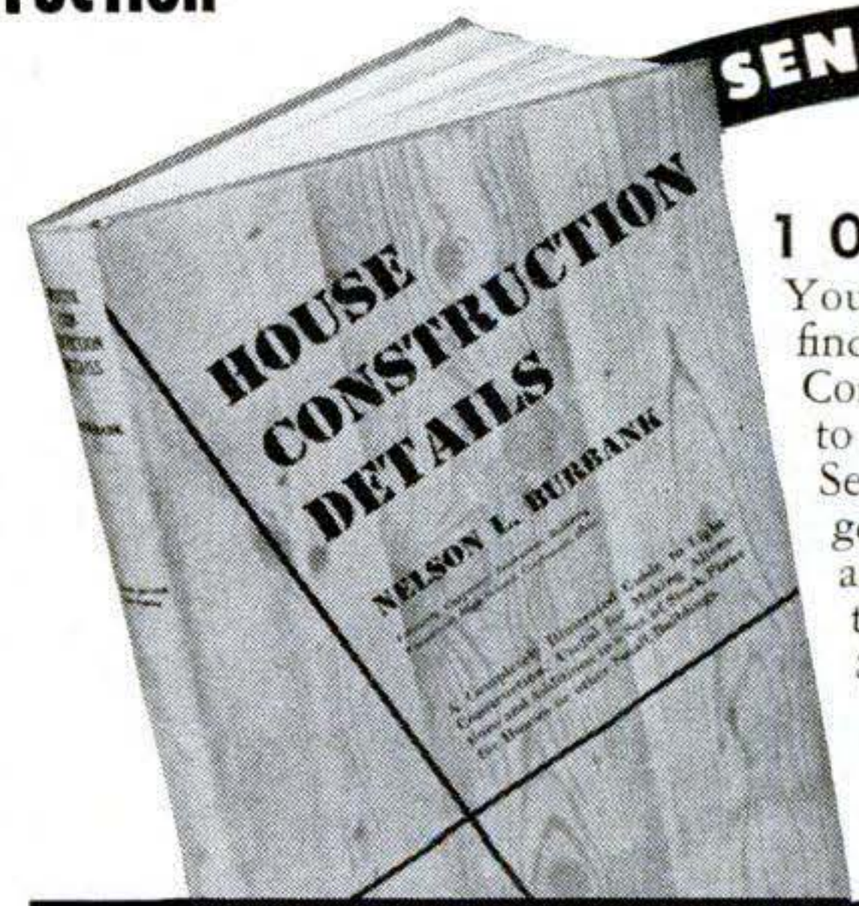

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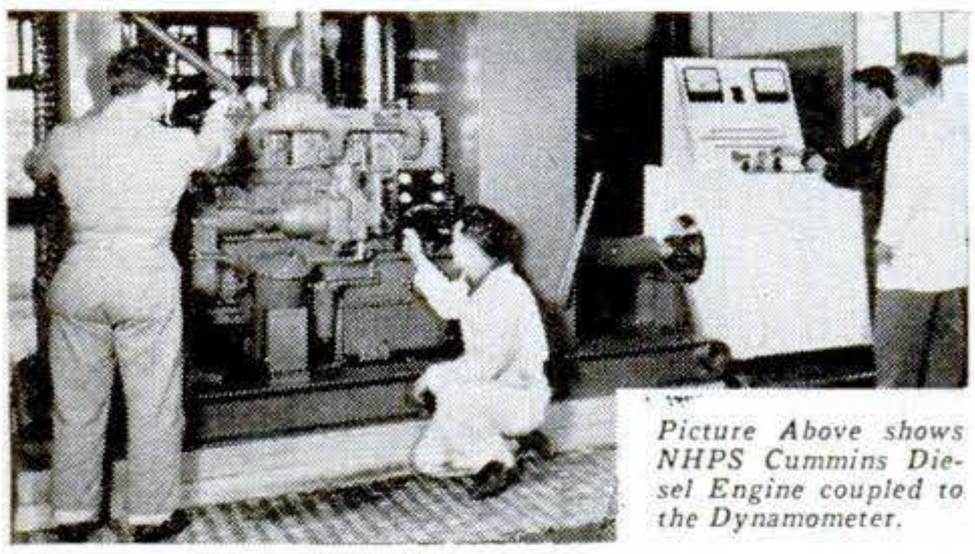

Picture Above shows NHPS Cummins Diesel Engine coupled to the Dynamometer.

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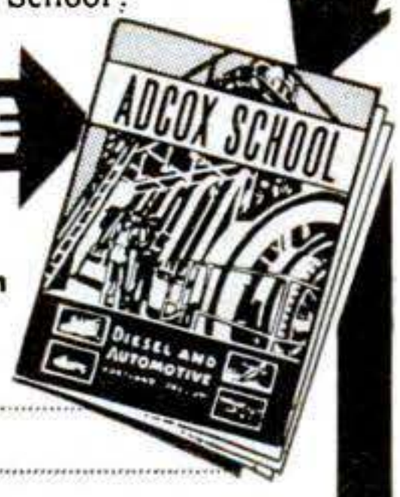

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Letters

Chicago Has a 'Chute Jump, Too

Sir:

Your article "How You Are Thrilled . . . but Not Killed" was very interesting, but the statement made on page 87 that the parachute jump at Coney Island's Steeplechase Park is the only one of its kind set me wondering.

Living in Chicago, I have gone to Riverview Park and ridden on the parachute jump there. And according to your picture of the jump, I find no difference. Am I wrong?

(Mrs.) ANN RUBACK

Chicago, Ill.

Reader Ruback is one of many loyal Chicagoans who jumped to the aid of their native city by chiding PS for this omission.

Got a Screw Loose?

Sir:

Here's a helpful hint to the owners of cars who like to keep them in shape and fix small items that have gone on the blink.

I have found in various places on autos, especially the older ones, that the screws which hold the framework around the windows and windshields on the inside have become loose, and in some cases won't tighten up sufficiently to hold the frame.

I have found that an excellent way to help this is by taking the screw out and stuffing a small wad of steel wool in the hole, re-inserting the screw and tightening it again. This has worked time and again for me.

THOMAS M. CARLYLE

Englewood, Colo.

Then a Tire Blows . . .

Sir:

In your editorial on the new cars (April, p. 103) there was a paragraph that said that cars must be made for *use:* "That they are not going to be parked in the middle of a five-acre field, or driven only on lonely roads." That is very appropriate to the point I wish to make.

For your article on the new Kaiser utility sedan in the same issue (p. 106) shows

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To the man who wants to enjoy an ACCOUNTANT'S CAREER

IF you're that man, here's something that will interest you.

Not a magic formula—not a get-rich-quick scheme—but something more substantial, more practical.

Of course, you need something more than just the desire to be an accountant. You've got to pay the price—be willing to study earnestly, thoroughly.

Still, wouldn't it be worth your while to sacrifice some of your leisure in favor of interesting home study—over a comparatively brief period? Always provided that the rewards were good—a salary of $3,000 to $10,000?

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Just suppose you were permitted to work in a large accounting house under the personal supervision of an expert accountant. Suppose, with his aid, you studied accounting principles and solved problems day by day—easy ones at first—then more difficult ones. If you could do this—and could turn to him for advice as the problems became complex — soon you'd master them all.

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For your own good, don't put off investigation of *all* the facts. Write for our free 48-page book, "Accountancy, The Profession That Pays." It'll prove that accountancy offers brilliant futures to those who aren't afraid of serious home study. We'll also include "Ten Years' Promotion in One"—a book which has helped many men. Send us the coupon *now.*

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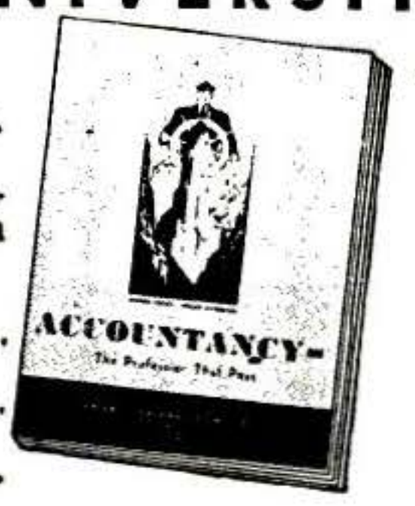

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The educational benefits that the government offers qualified veterans under the G.I. bill are extremely valuable. They provide a splendid opportunity to learn a profitable trade—with the Veterans' Administration paying the tuition.

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"Please accept the thanks of an average man who now feels that he has taken a big step on the road to becoming more educated and independent." . . . "As you can see, I am now on my own. It came sooner than I had anticipated, and with the training I've received from C.T.I., I'm sure I'll go places, but fast!" . . . "I recently went into business for myself. I wish to thank you for C.T.I. training, for it has provided a great future for me." . . . "I now operate a very successful business. Have a $12,000 building and $4,000 worth of stock and equipment." . . . "Recently I completed C.T.I. training. Less than three hours after looking for a job, I found one. The training of your school developed my ability far more than I dared think." . . . "I now have an interest in a small shop. If it were not for C.T.I. training I would not be where I am today." . . . "I have found my course of study the finest I've ever seen. It is very interesting. Cooperation of C.T.I. is outstanding." . . . "I cannot thank you enough for the training I have received. I have made good progress, and have had three raises in pay within eight months."

If you are bottle-necked by a job that has no future or a wage that is too low, do as so many others have done—train yourself for advancement through C.T.I. Your next step is to write C.T.I. or mail coupon for free, illustrated booklet. *Act today!*

VETERANS! C. T. I. COURSES ARE G. I. APPROVED

R. C. Anderson
President

All C.T.I. courses, both residential and home study, are fully approved by the Veterans' Administration—which means that eligible veterans will have their tuition paid by the government. Remember, there's a time limit on when training must begin, so act now. NON-VETERANS—We'd like to tell you about our Easy-Payment Finance Plan and Pay-After-Graduation Plan. Write for information.

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Qualified veterans with only three months of military service are entitled to as much as four years of home study training. C.T.I. will assist you in making proper application. Unless you already have extensive technical skill, you eventually will need training if you are to succeed. So why delay writing to C.T.I. for the facts?

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HOME OF C.T.I.

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All good mechanics, like good doctors, should know the working theory and operation of each part and understand what causes trouble and how to remedy it.

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Every auto mechanic, helper, serviceman and operator can use a copy of AUDELS AUTOMOBILE GUIDE. The information it gives saves time, money and worry. Highly indorsed by all users. It presents the whole subject of auto mechanics from A to Z in plain language and simple terms.
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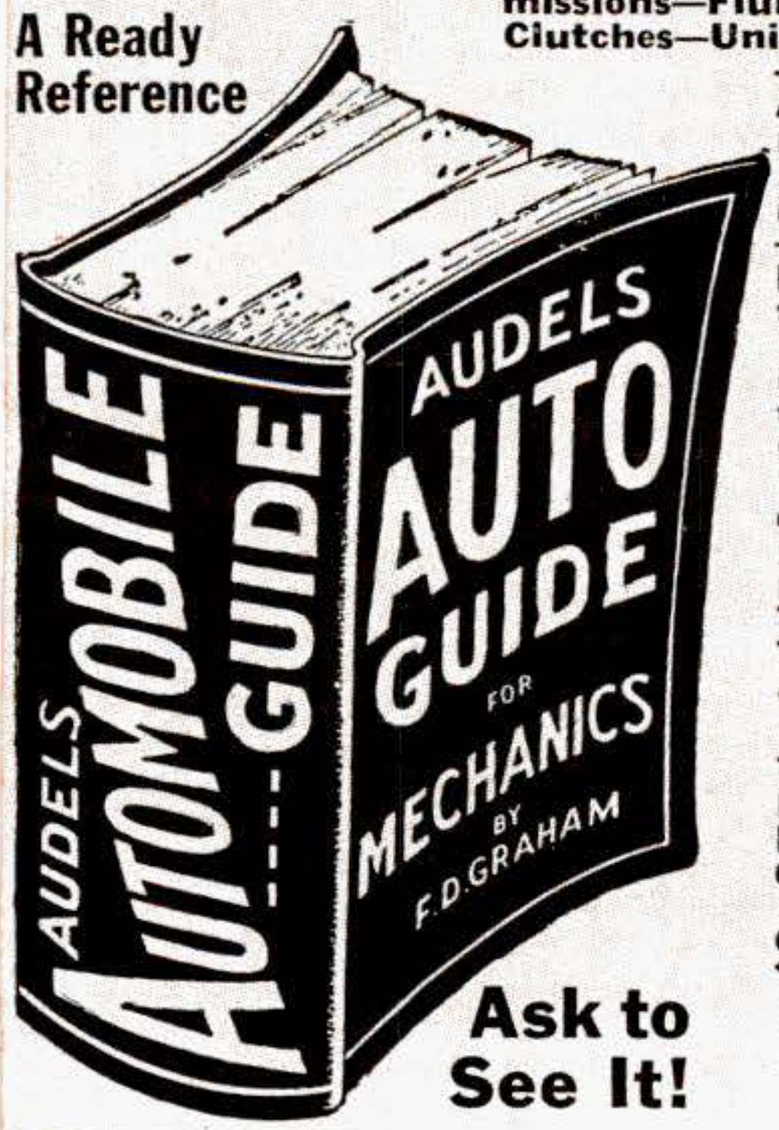
A Ready Reference



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TRAIN IN MIAMI--AIR CAPITAL OF THE WORLD

how its spare tire is carried at the side of the cargo compartment, bolted to the inside of the dummy left rear door.

Now, suppose the car is driven up to a camp in the mountains some dark and rainy night. There is a lot of bulky and/or perishable material in the rear and it is really packed in—as shown in your cover picture.

Then a tire blows. HOW IS THAT TIRE GOING TO BE GOTTEN OUT OF THE BACK COMPARTMENT?

PHILIP K. SCHMIDT

Plainville, Conn.

Answering your question is another item for the unfinished business of making cars for use as well as looks.

Merry-Go-Round Won't Go Round

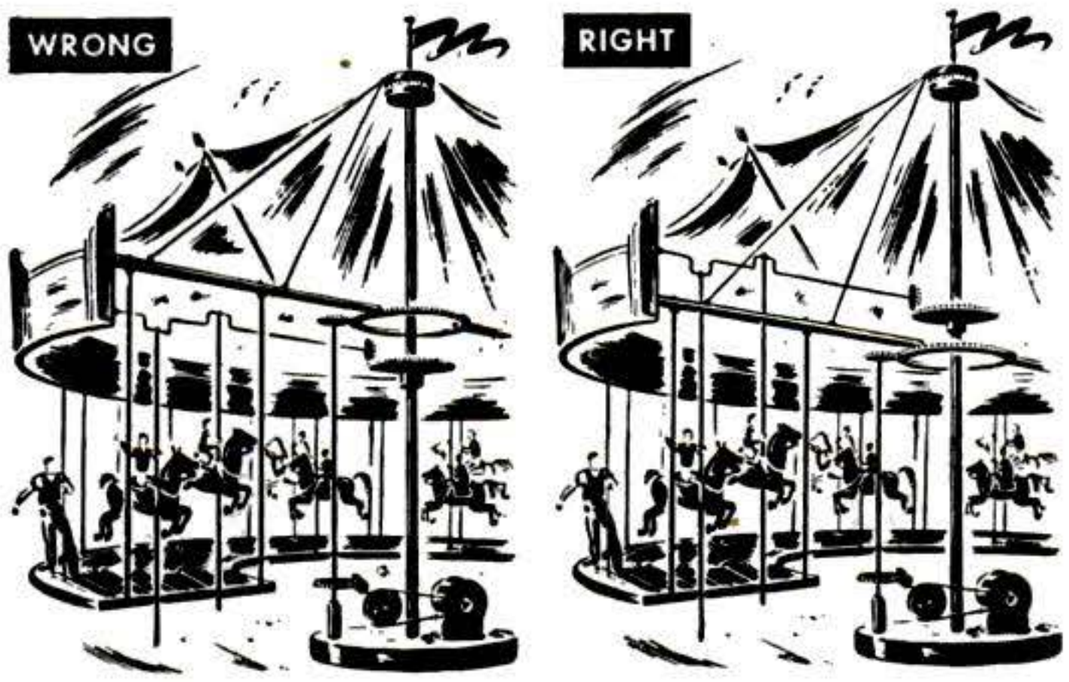
Sir:

I subscribed to POPULAR SCIENCE for my son so that he would grow up with an interest in science and mechanics.

I wouldn't like him to design a Merry-Go-Round like the one shown on page 84 of the July issue ["How You Are Thrilled . . . but Not Killed"]. Why don't you give your artist a free subscription to POPULAR SCIENCE so that he can learn the fundamentals.

JAMES W. MOLLER

Tulare, Calif.



PS has given artist Pioch a free subscription, in return for which he has redesigned our merry-go-round, as shown above, so that it won't tear itself to pieces.

Wax Saves Cement

Sir:

On page 209, in the June issue of POPULAR SCIENCE, appeared "Model Parts Molded from Metallic Cements." I advise that after the mold hardens, especially when using

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I TRAINED THESE MEN

"N. R. I. helped qualify me for position as Radio Mechanic with United Airlines. Have my Radiotelephone 2nd Class License."—L. M. Hauger, San Bruno, Calif.

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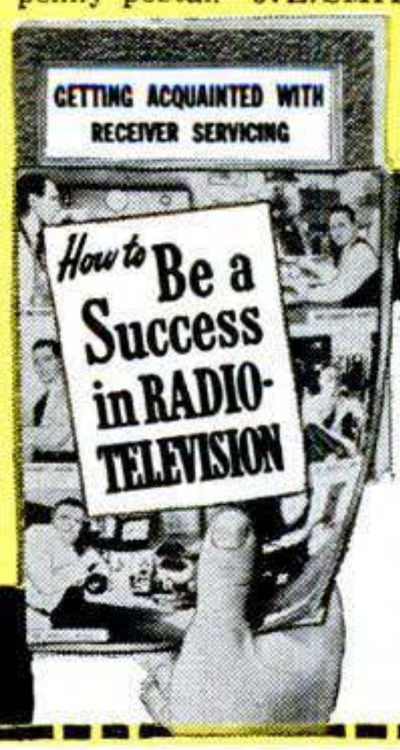
"I am operating a Radio Sales and Service business. With FM and Television in the offing, we have a very profitable future."—Albert Patrick, Tampa, Florida.



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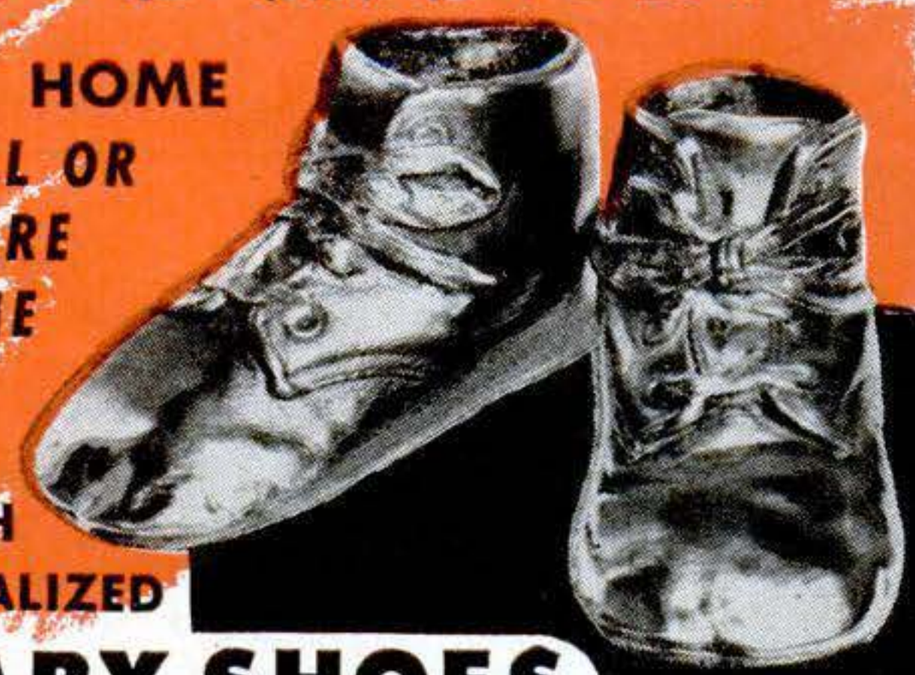

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large amounts of metallic cement for the subject, you test the mold by letting the wax from a burning candle run into it.

When the wax is removed, you will get a first-hand picture of what the object will look like from the wax impression. If the impression is not satisfactory, the mold can be done over, thus saving you quite a bit of metallic cement.

MORT KOSTIN

Brooklyn, N. Y.

Plows Make Progress

Sir:

On page 112, June issue, you show a picture of a new type of sagebrush plow, and you have given the U. S. Forest Service credit for developing the plow.

In 1947, along in the summer, the first plow of this type to be used in the U.S.A. came from Australia and was shipped to Boise, Idaho, and was hauled out and tried on the Idaho sagebrush. The reason the plow was tried out in Idaho, near Boise, is that there are several dams being constructed in the area, and there are many miles of irrigation ditches constructed near Caldwell, Idaho, which is about 75% sagebrush. The soil is good with irrigation, so a way had to be found to get the sagebrush out at a minimum of cost. This plow was shipped over from Australia, and that means the U. S. Forest Service did not develop it.

CARROLL P. GRAVES

Bryte, Calif.

An Australian plow, called the Sungeneral "stump-jumper," was first tested out at Boise and other places, but, giving the Australians due credit for their idea, the plow just wasn't rugged enough for the job. The Forest Service then incorporated its best features with those of several makes of American wheatland plows and came up with the "brushland" plow shown in PS. Besides being less susceptible to breakage than the Australian model, the brushland plow has a more efficient knee action.

Push-Button Problem

Sir:

I live in a four-room apartment and have many electrical appliances, including an electric mangle which runs on 14.6 amperes.

Every time the mangle and any other electrical appliances are turned on there is an

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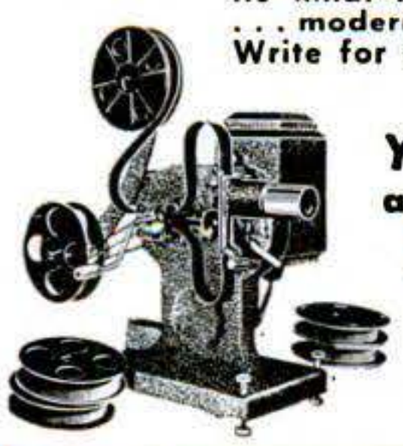

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overload and the fuse blows. I have increased the strength of the fuses to 25 amps., but the fuses still blow. I don't want to put in any stronger fuses for fear of the wires overheating and causing fire. The trouble seems to be in the powerful mangle, as the fuse only blows while it is on.

I am sure that this problem faces many people in this push-button age. A solution would be greatly appreciated.

PAUL S. ROTH

The Bronx, N. Y.

The use of 25-amp. fuses in standard 15-amp. branch circuits is highly inadvisable, and in many communities illegal. The only safe, practical solution is to have a licensed electrician install a separate 30-amp. circuit for the mangle. Even though the mangle may run on 14.6 amp., its starting draw is doubtless much greater.

Whoopee for Whittling!

Sir:

I was greatly surprised to find not one but *two* whittling articles in your April issue. It seems that magazines for some unknown reason shun whittling projects. I don't see why because there must be many whittling fans who would like to see such articles.

I think the article "Miniature Game Bird Whittled from Pine" [p. 198] by M. P. Casserly was exceptionally good. The "Horned Toad" [p. 193] by Elma Waltner was also good. I am sure you will increase your sales if you publish projects like these.

SPURGEON S. SMITH

Pennsauken, N. J.

Proof of the Pudding

Sir:

I most certainly enjoyed the article on "How Overdrive Works" in your April issue [p. 180]. On January 24, 1949 I purchased a 1949 Mercury Sport Sedan equipped with an overdrive. The Ford and Mercury dealer that sold me the car couldn't tell me very much about the overdrive, and after reading your article I discovered that what little they did tell me was all wrong.

It was very late in the evening when I finished the article, but I drove my Mercury around to see how the overdrive worked. Your article is correct!

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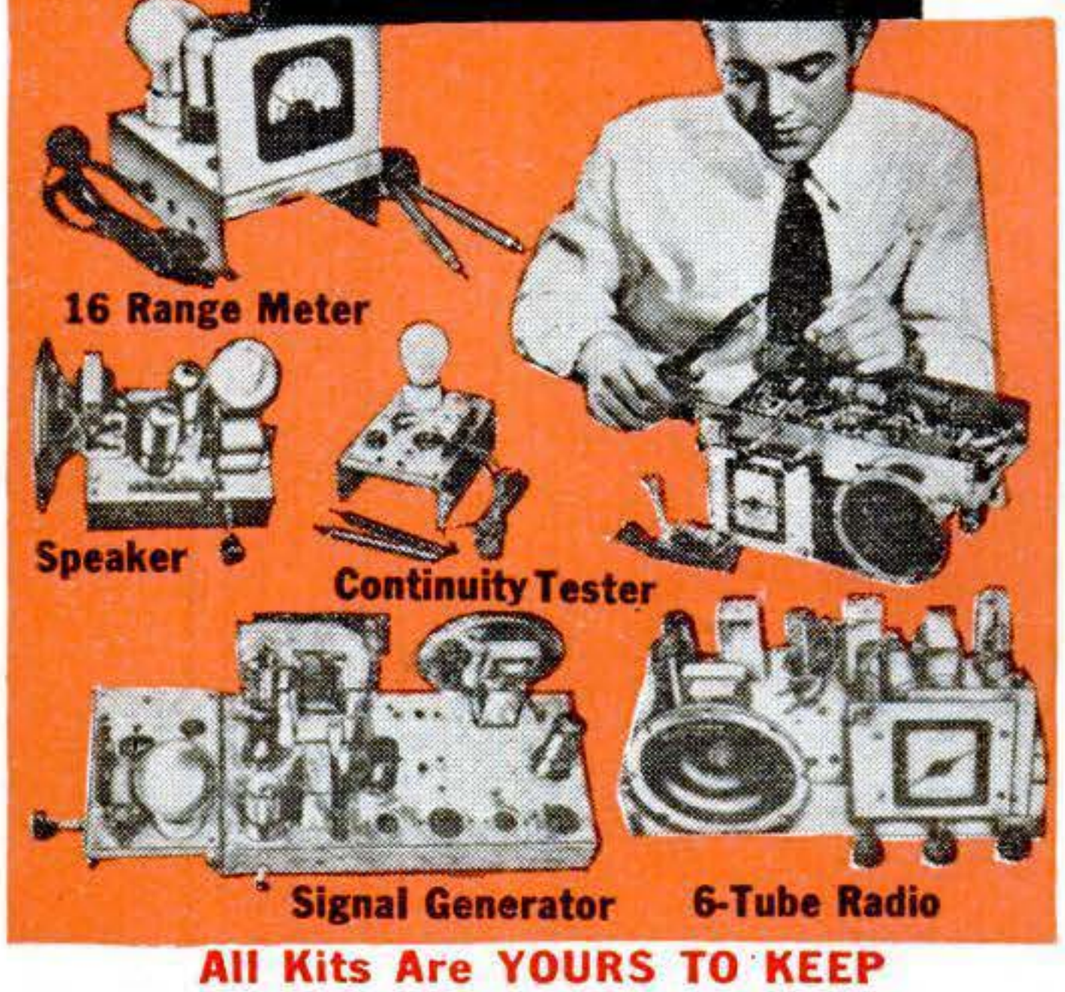

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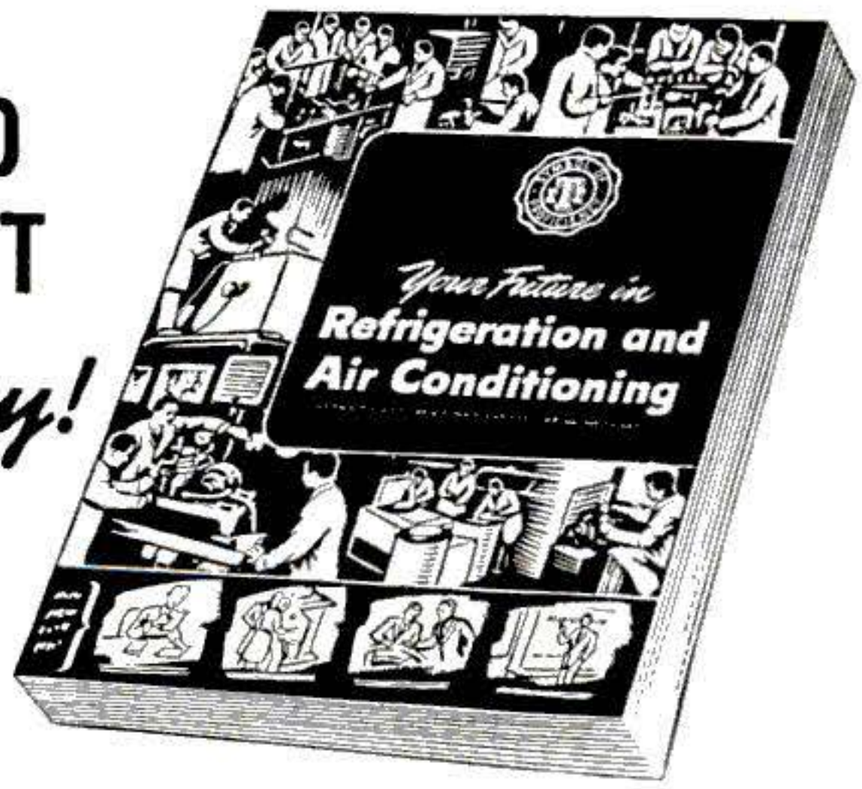

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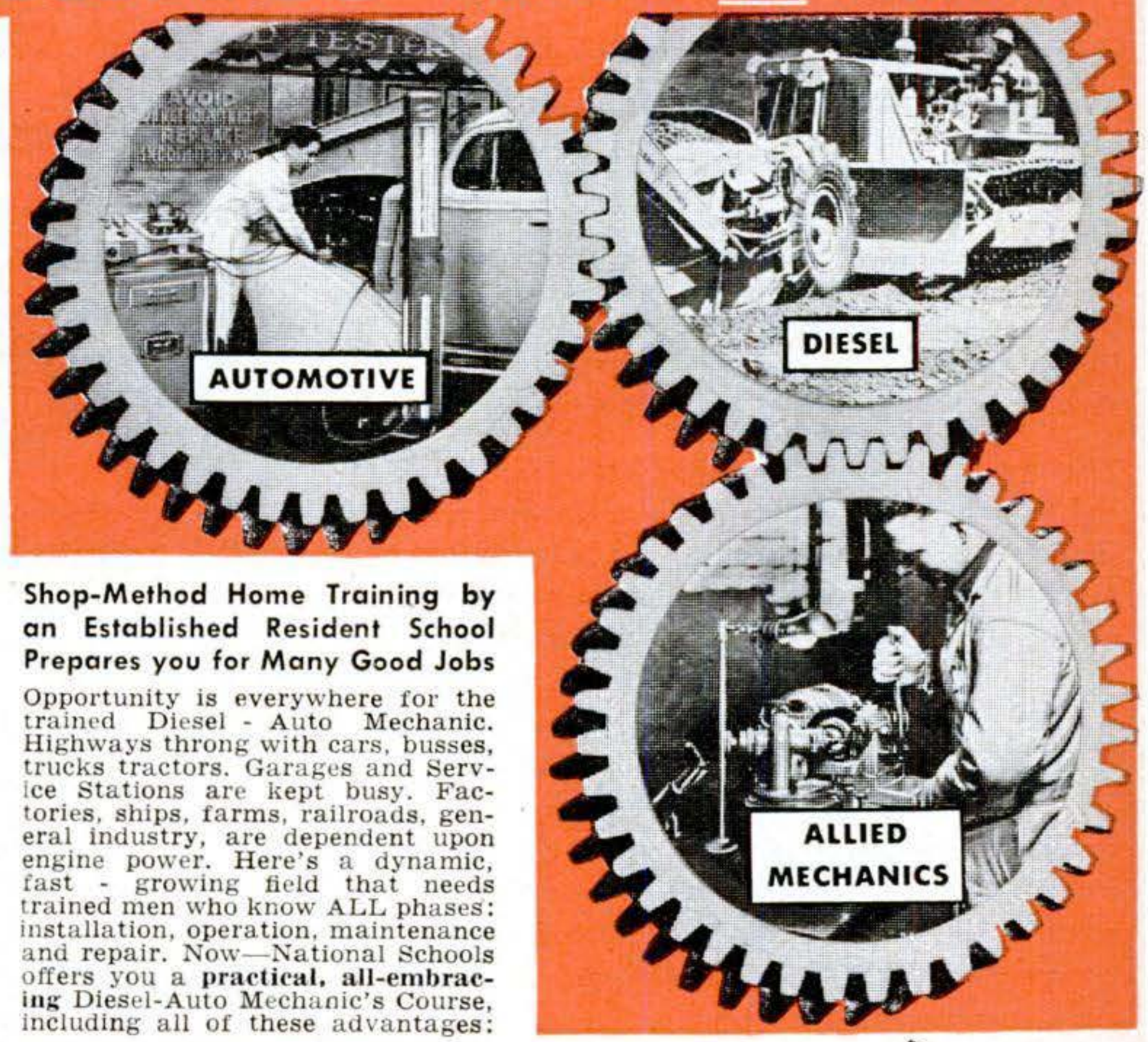

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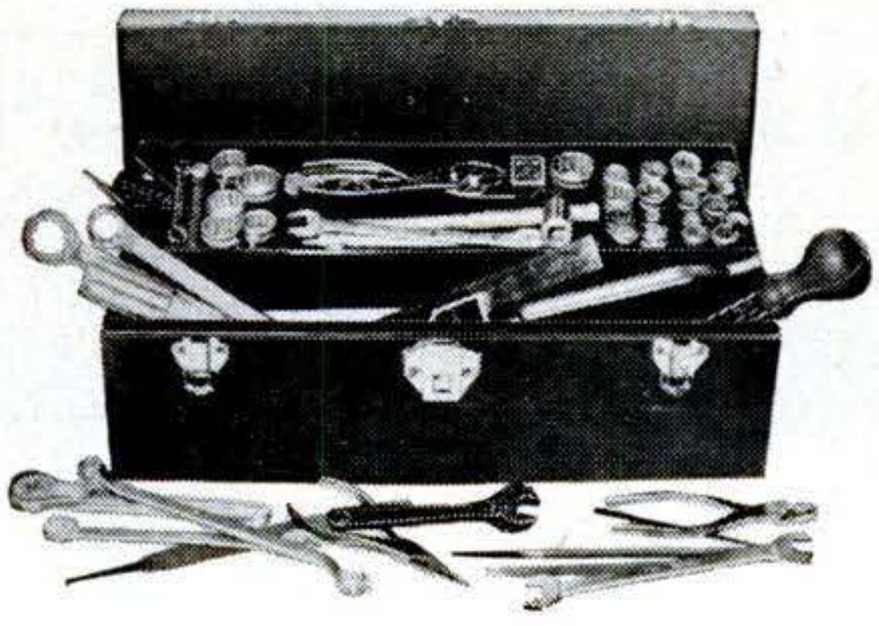

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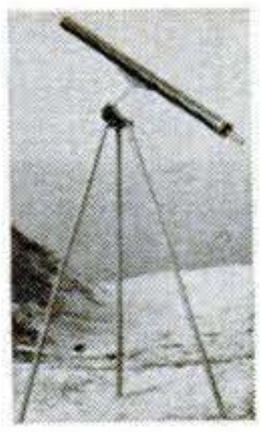

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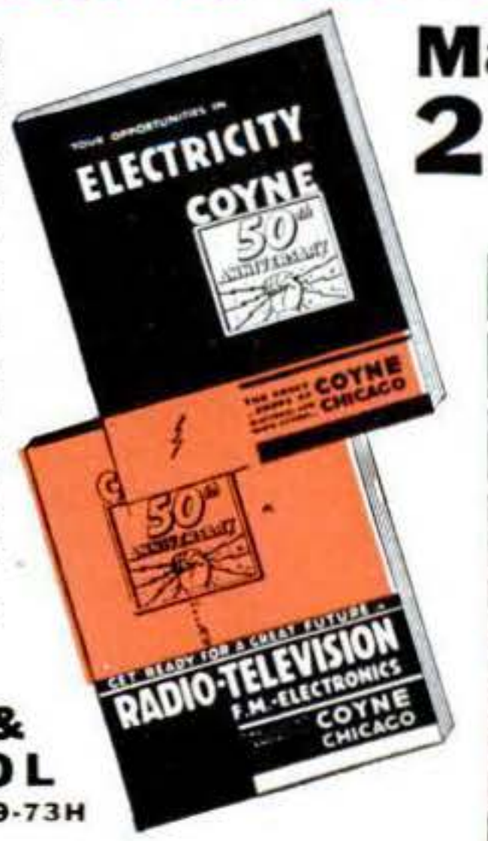

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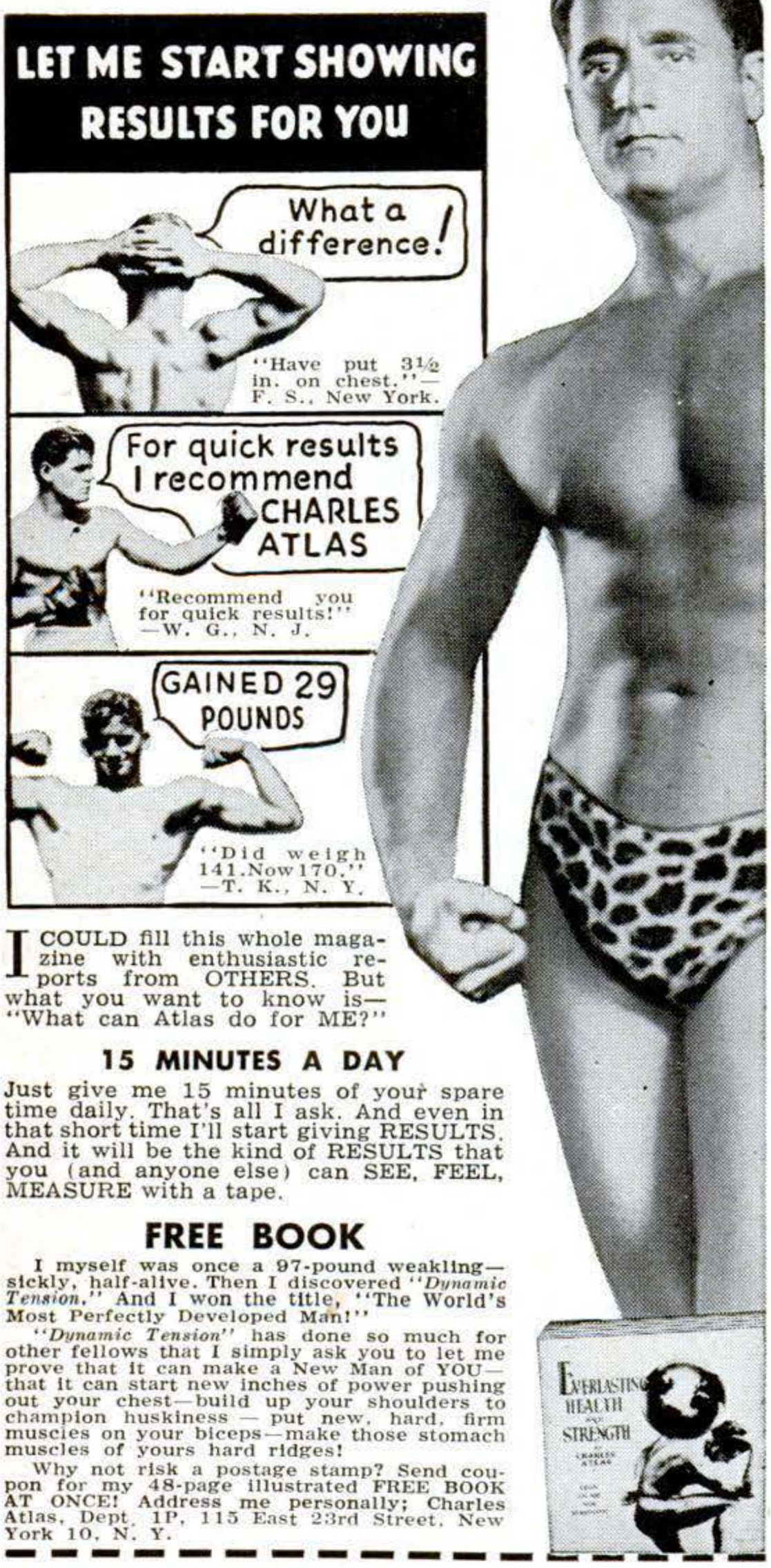

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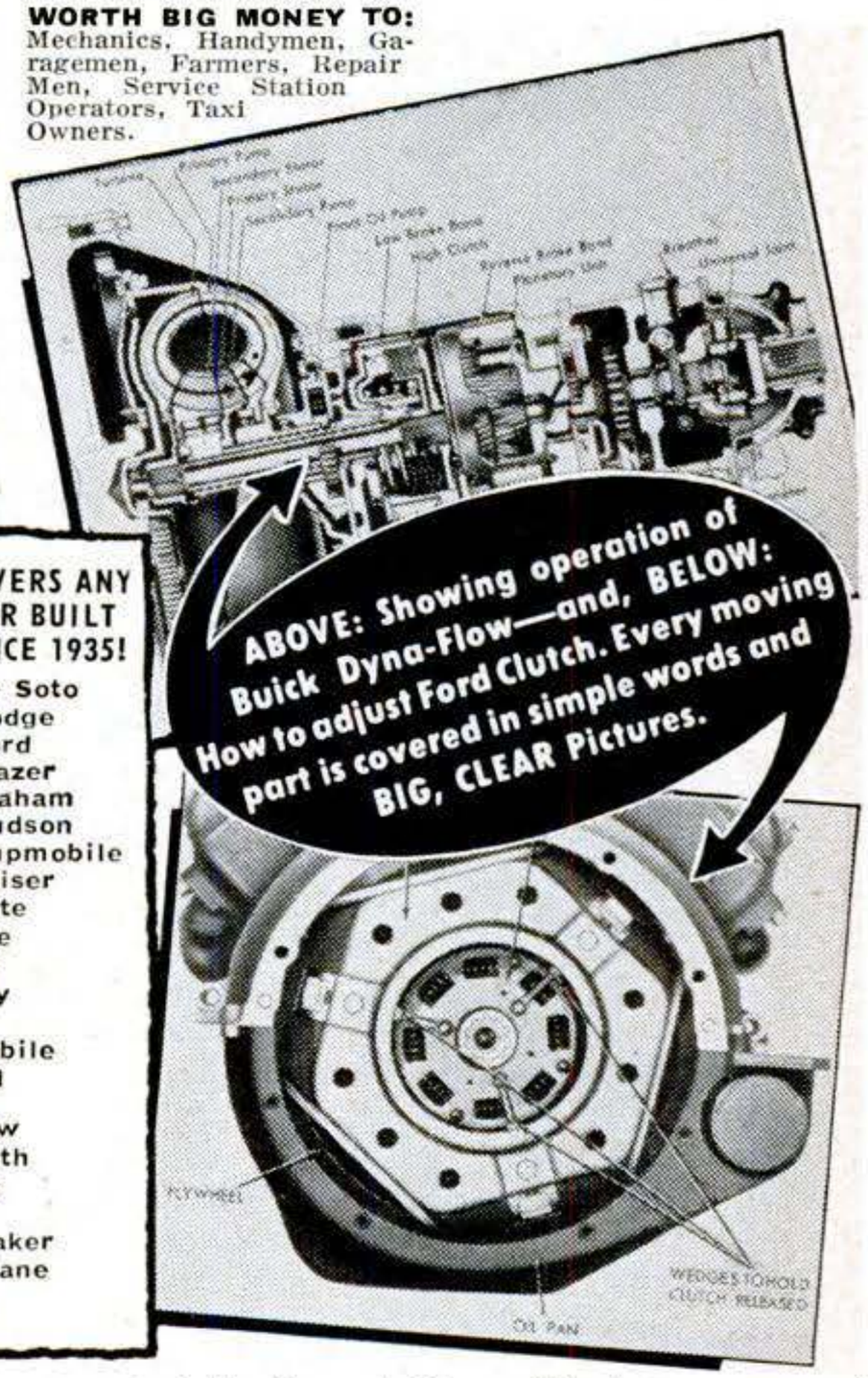

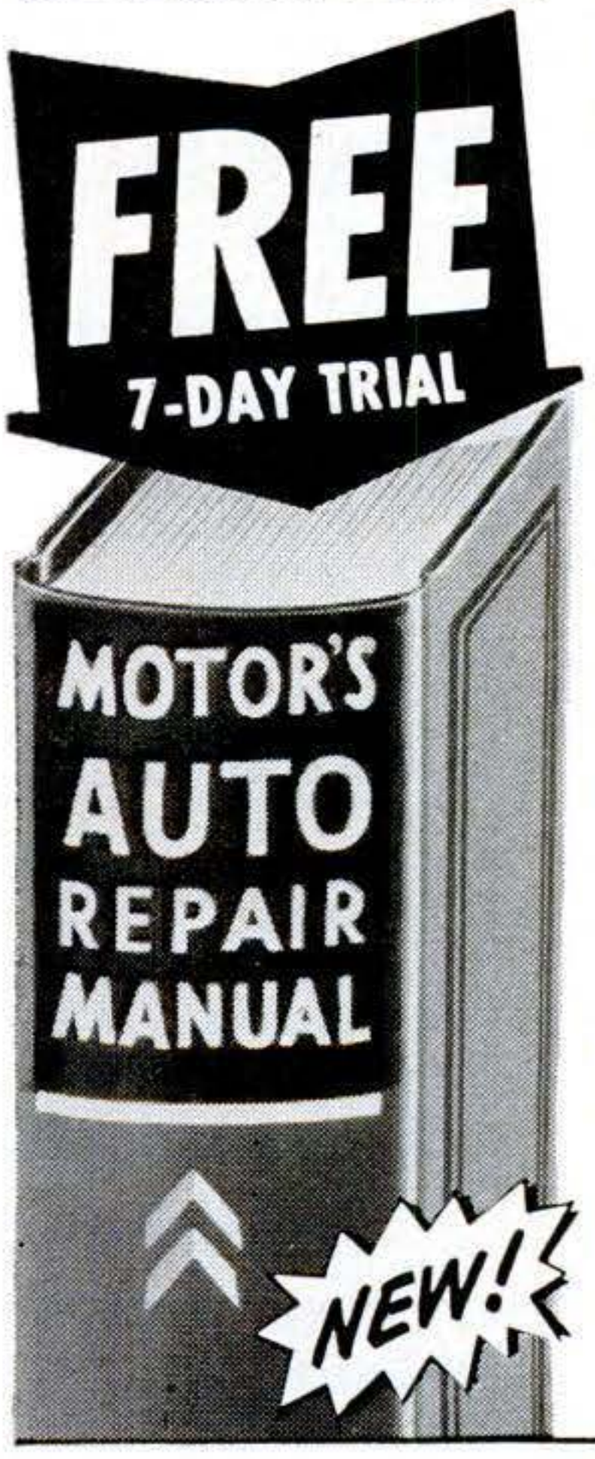

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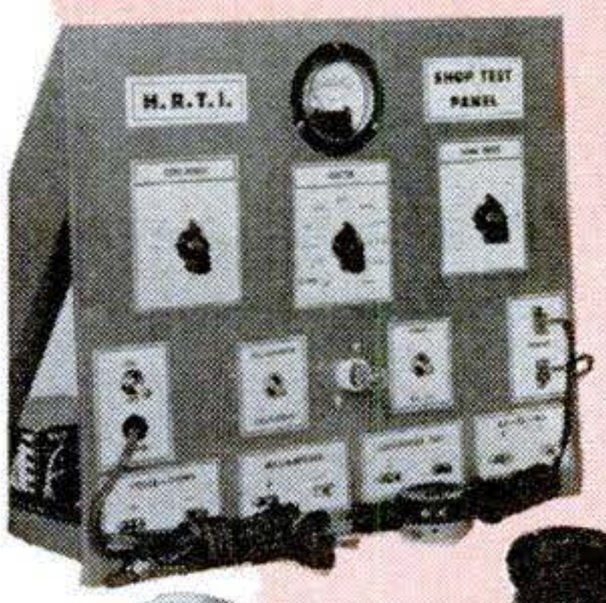

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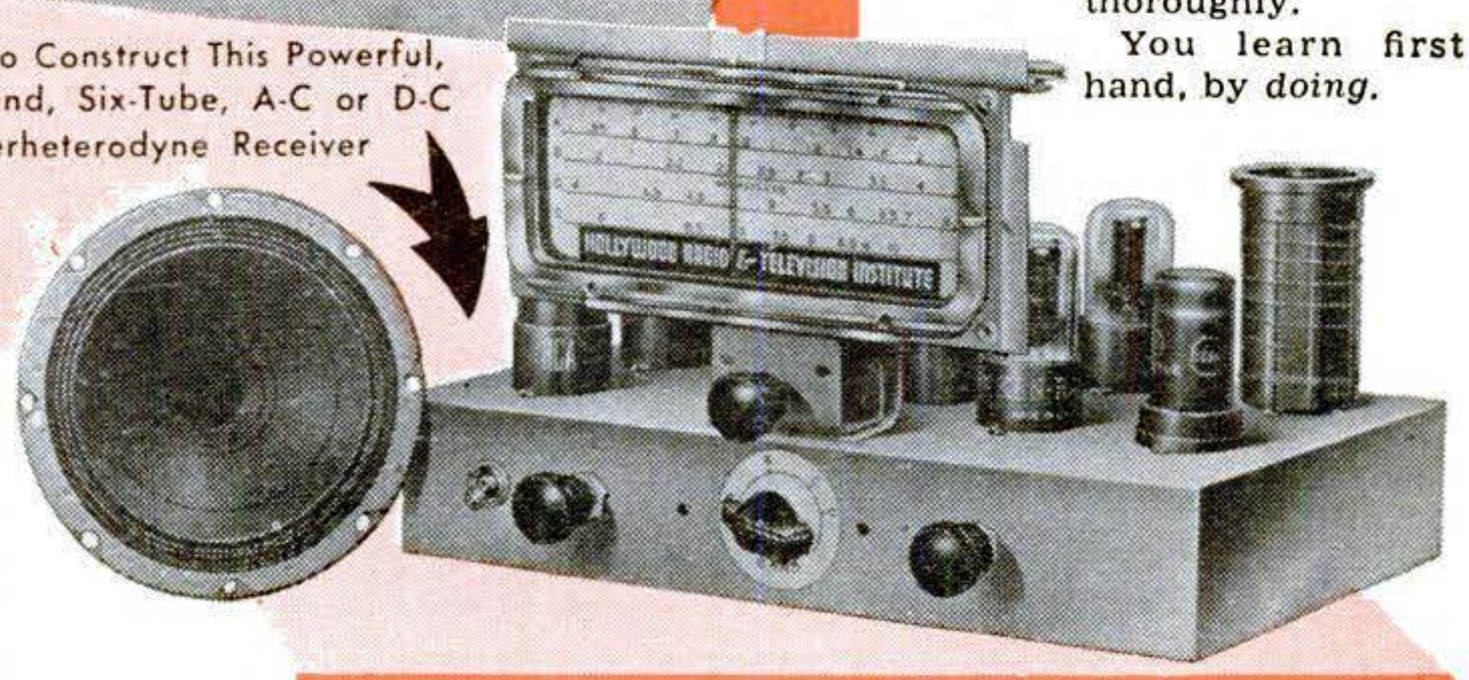

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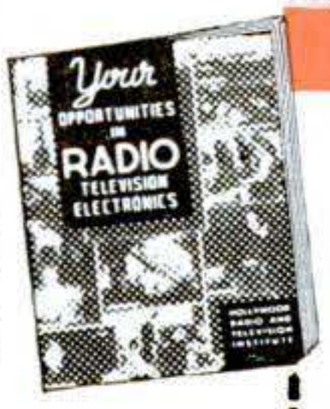

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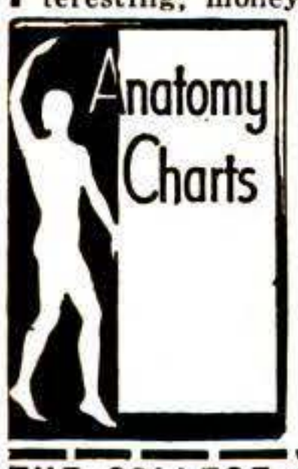

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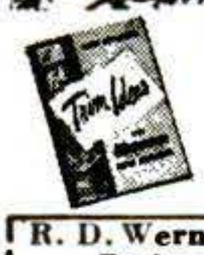

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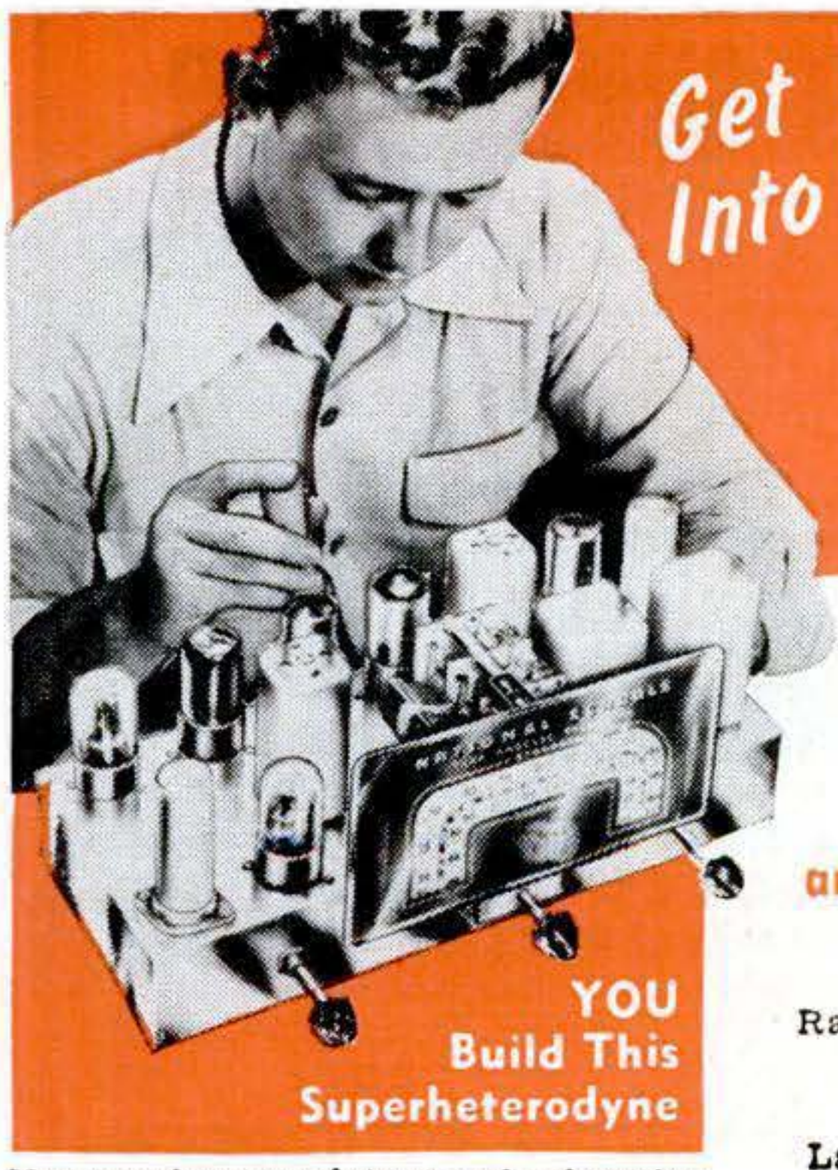

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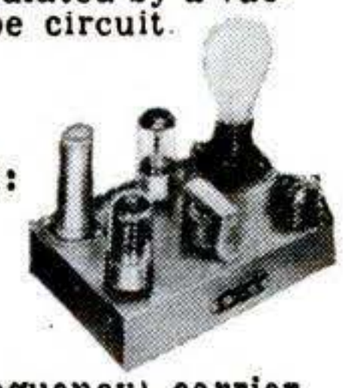

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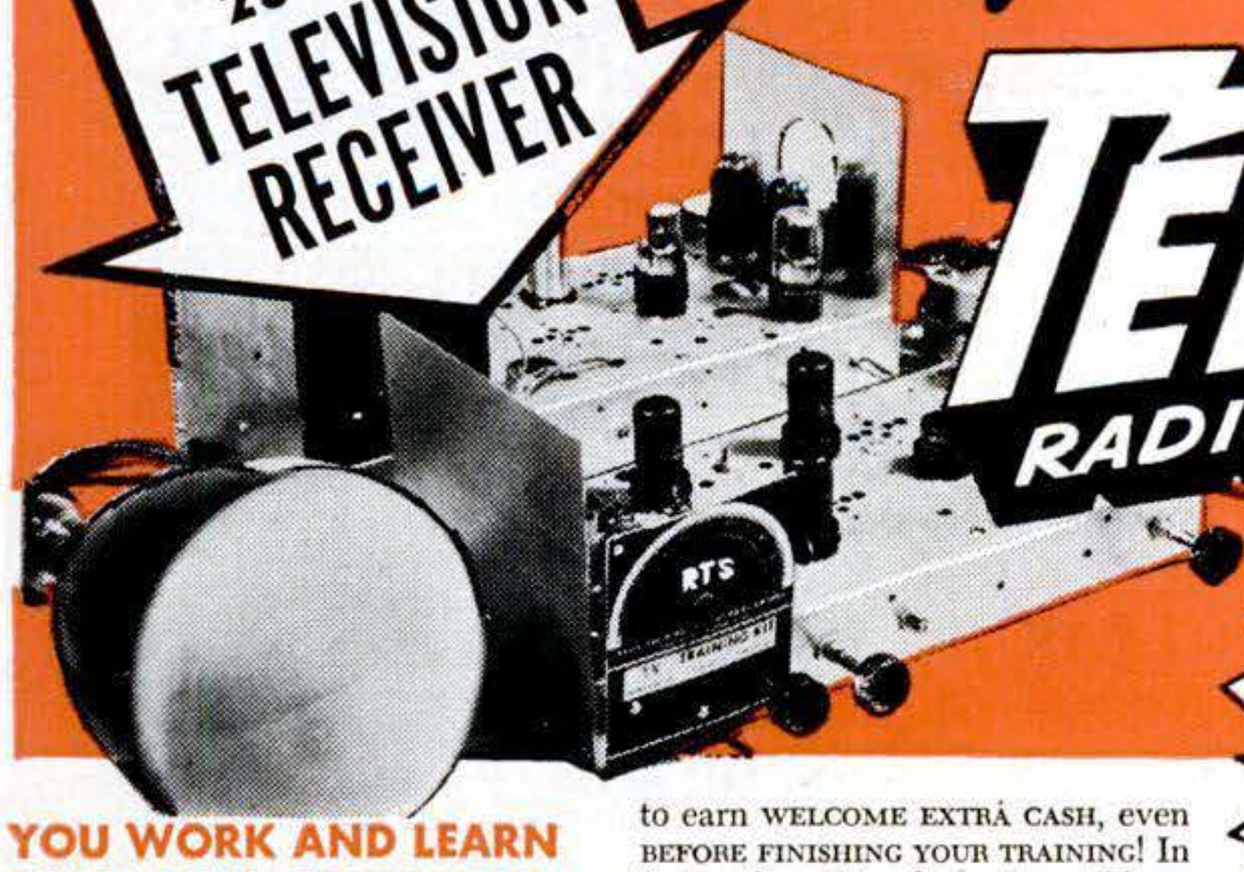

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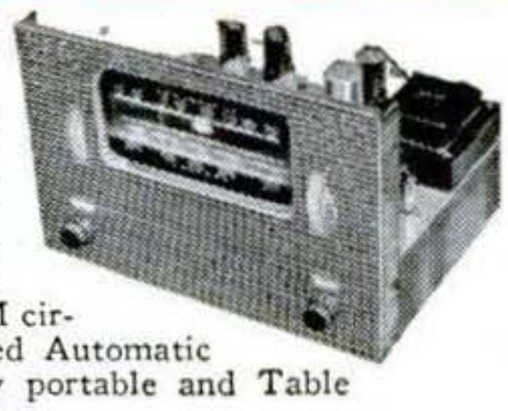

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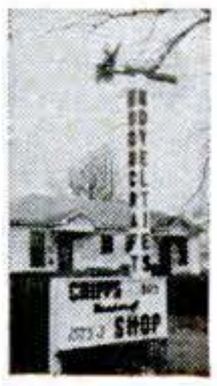

Five jigsawed end tables brought Mr. T. of Norfolk, Va. $100.

Mr. J. P., a war veteran of McLean, Texas charges between $2 and $4 an hour for making, repairing and refinishing furniture.

Mr. S. S., an Oregon mail carrier beat the high cost of living by selling the products of his shop. Last year he made $500 in spare time.

In Minneapolis, Mr. L. M. sold $1250 worth of toys through local stores.

Bernell V. Shaw of Norwalk, Conn. started with a few tools on hand and now is operating a large shop with three employees.

Oregon mail carrier made $500 in spare time making unpainted lawn chairs, benches, picnic tables, etc.

R. F. C. found himself in poor health and bought a jig saw to help pass the long hours. Last year his backyard workshop paid him nearly $1000.

Jack Keegan of Bridgeport, Conn., runs a profitable sideline business in his spare time selling $1.00 novelty articles. He holds down a steady job during the day.

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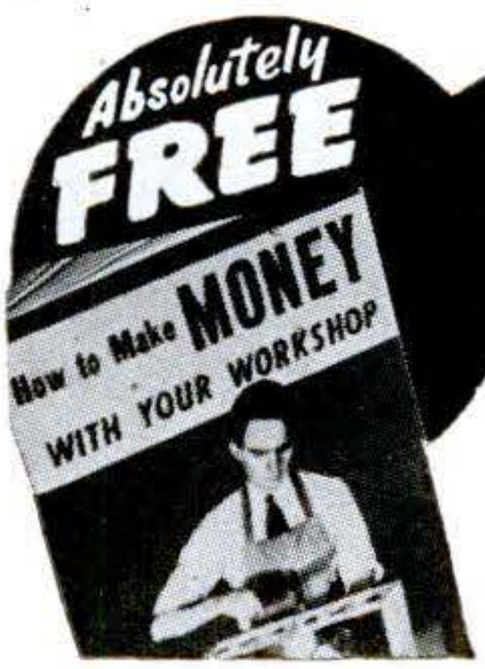

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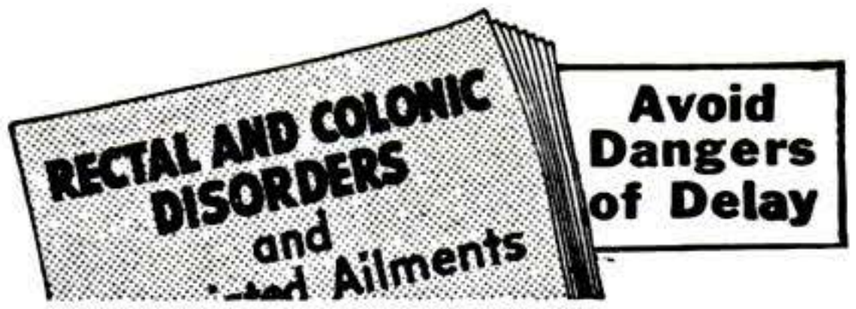

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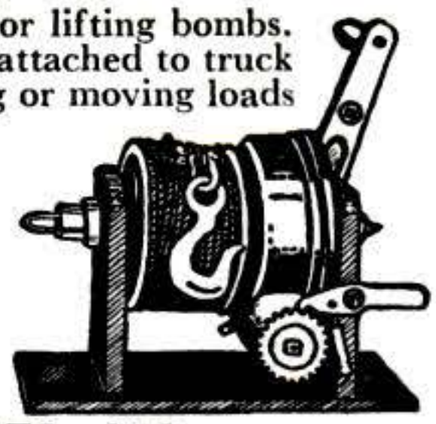

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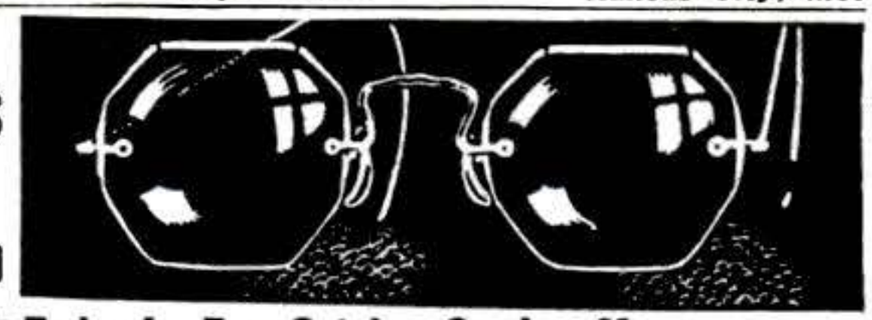

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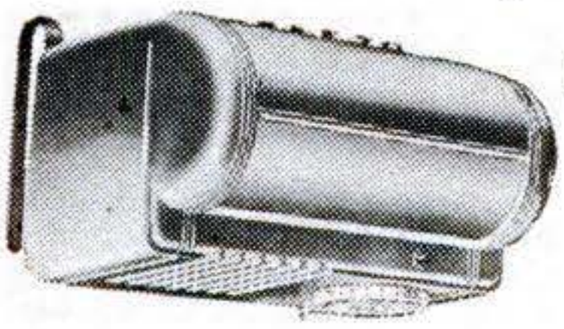

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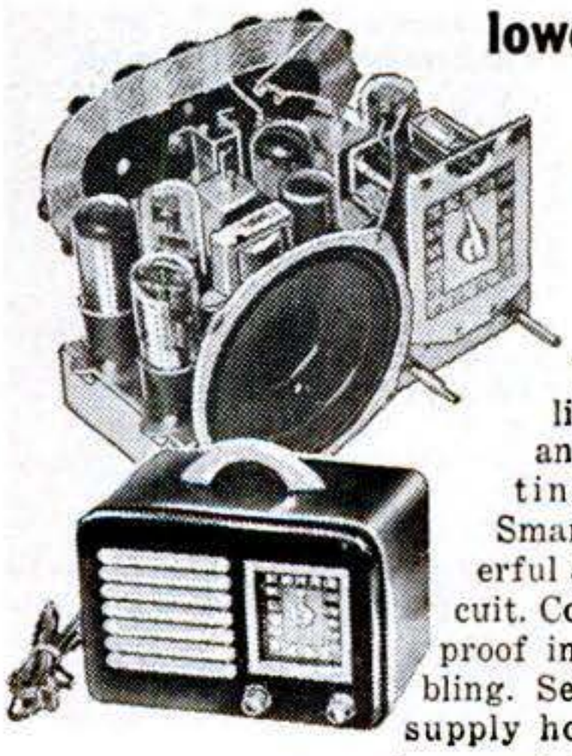

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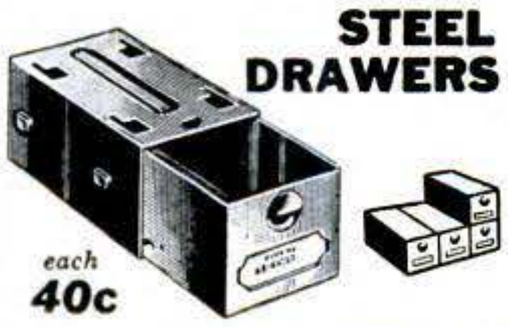

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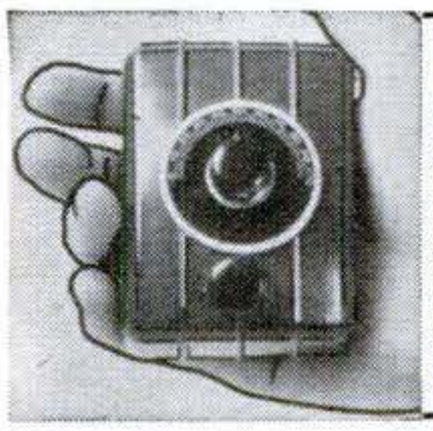

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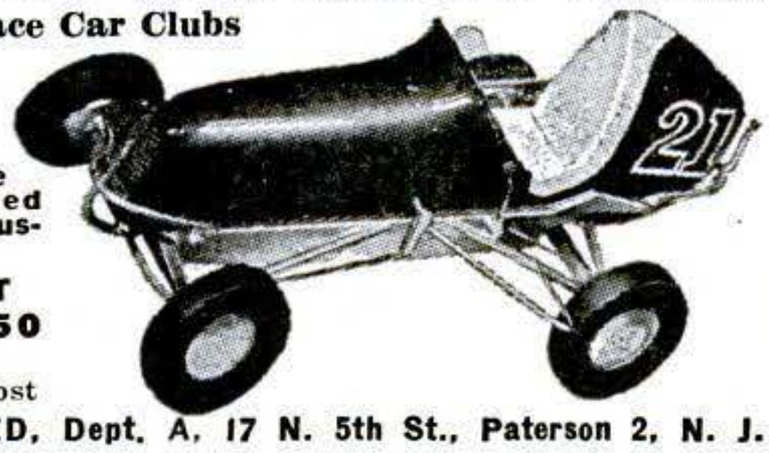

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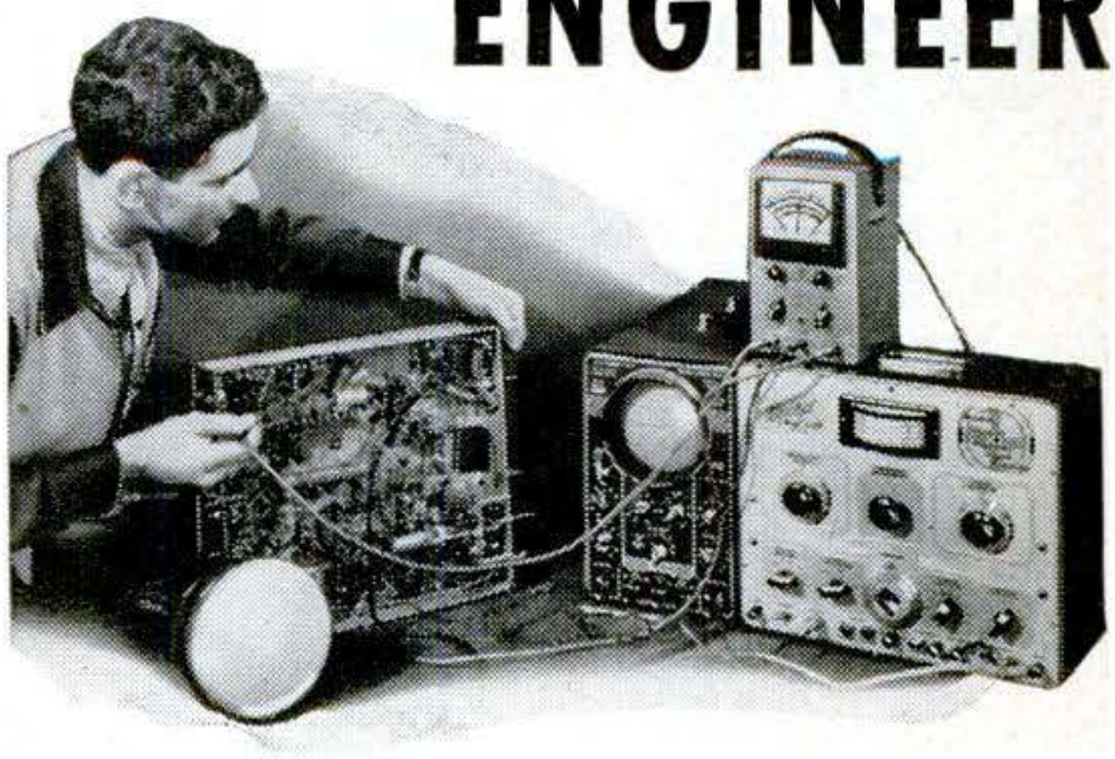

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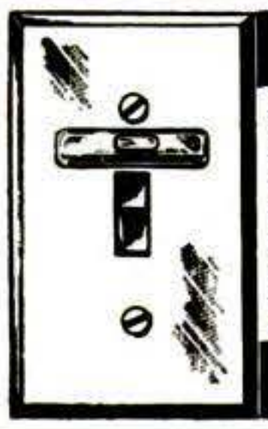

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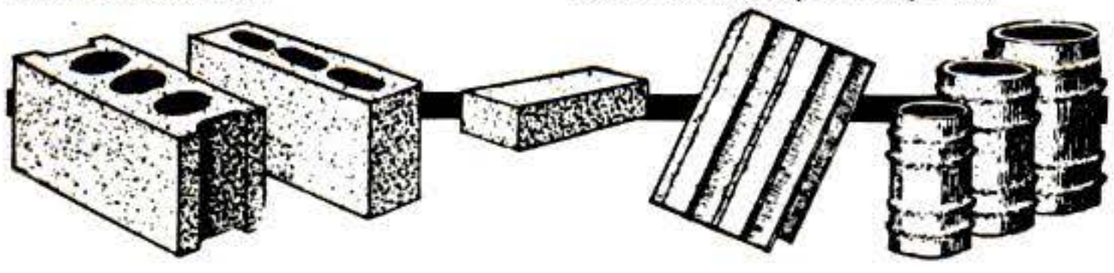

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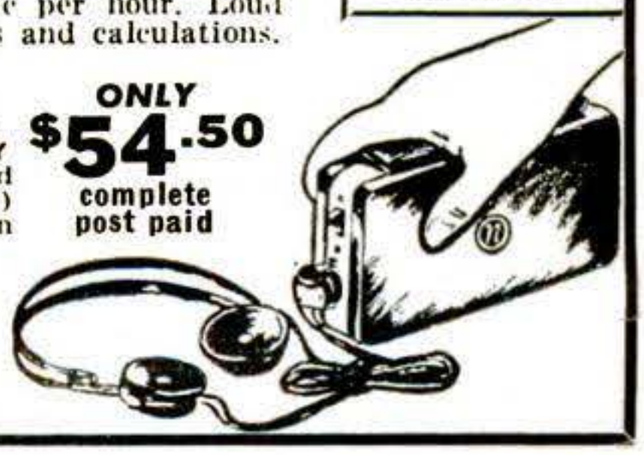

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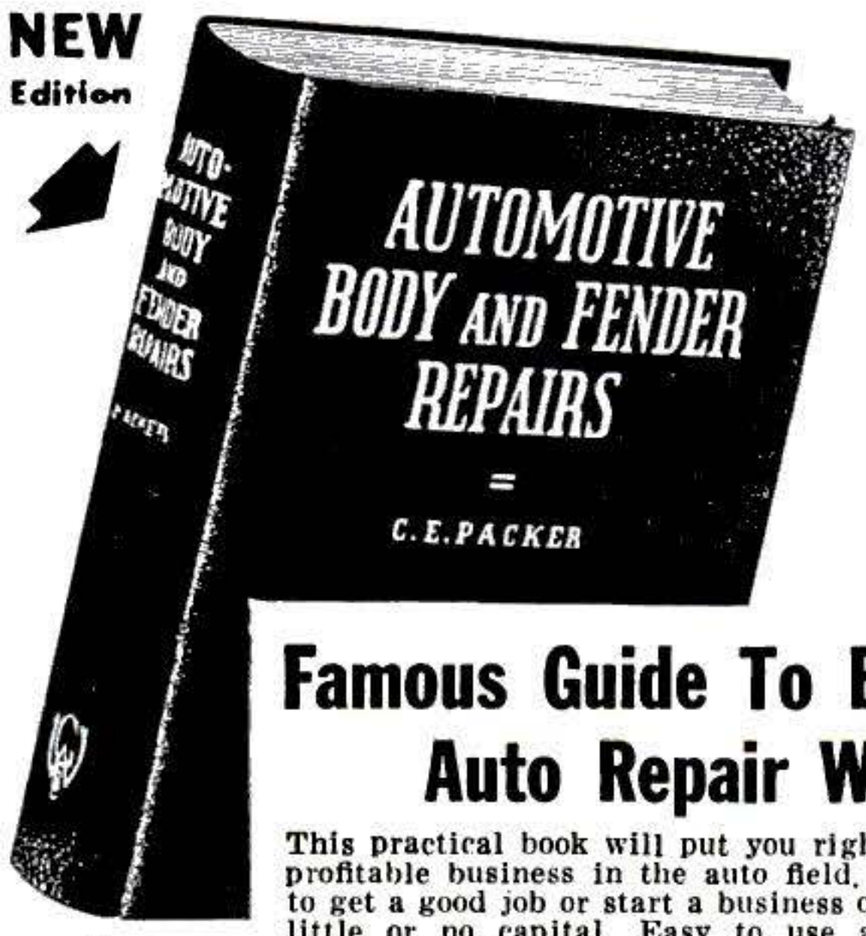

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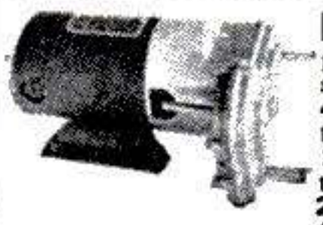

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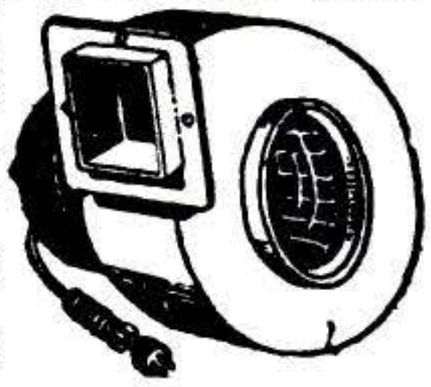

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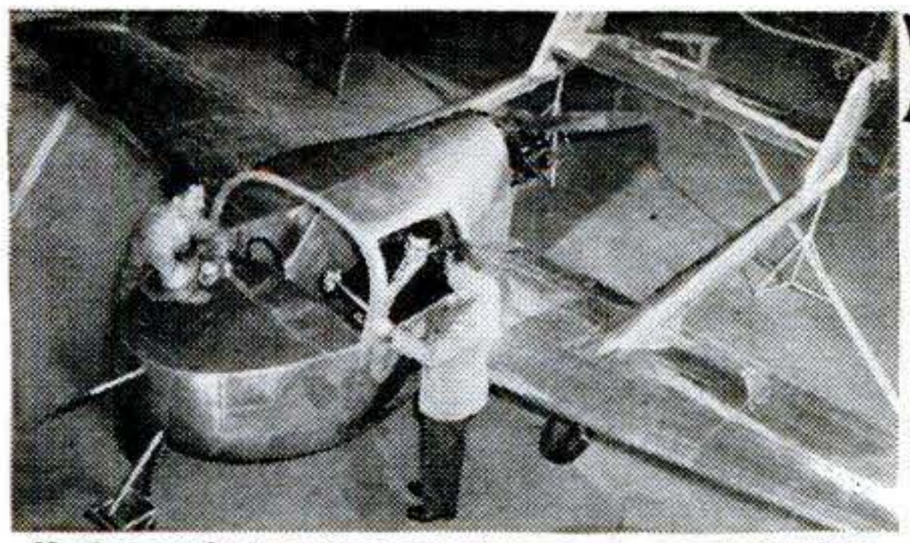
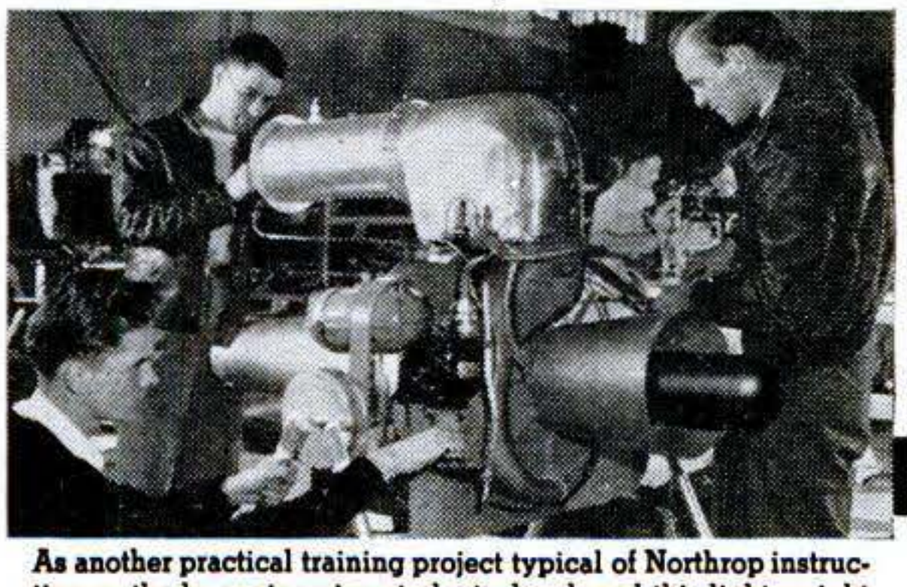


Northrop student engineers consult on new type control system for student-designed private plane. Complete metal mock-up was fabricated and assembled by students as part of training.



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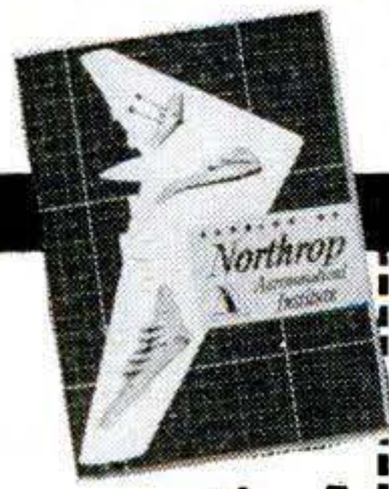

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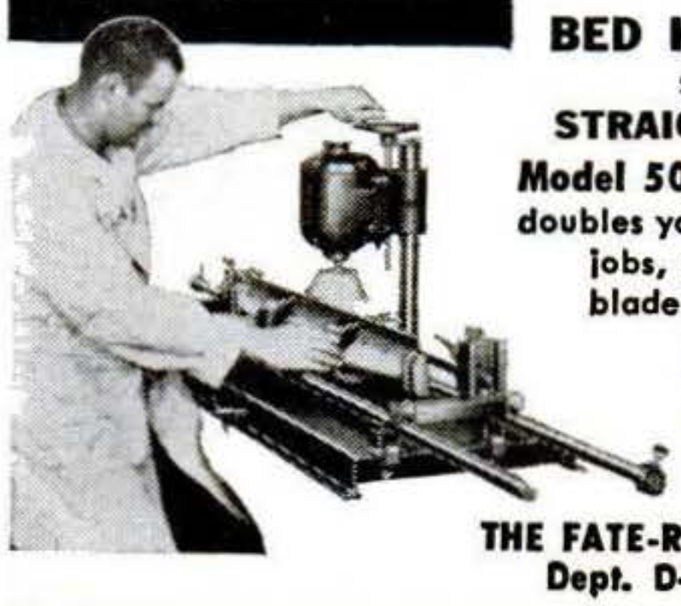

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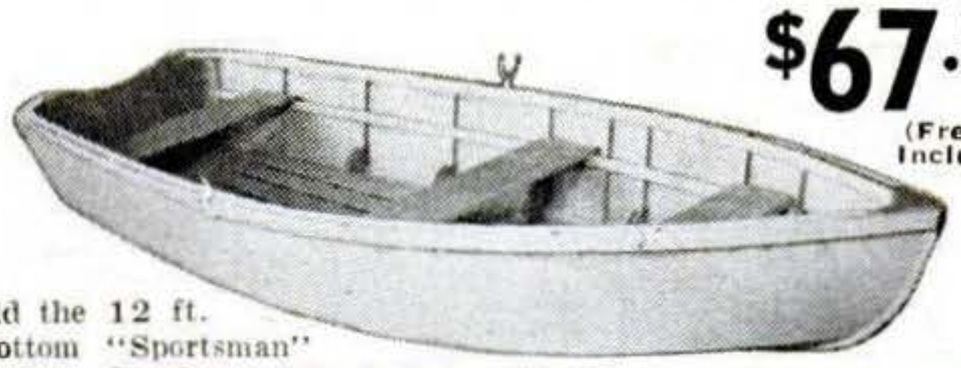

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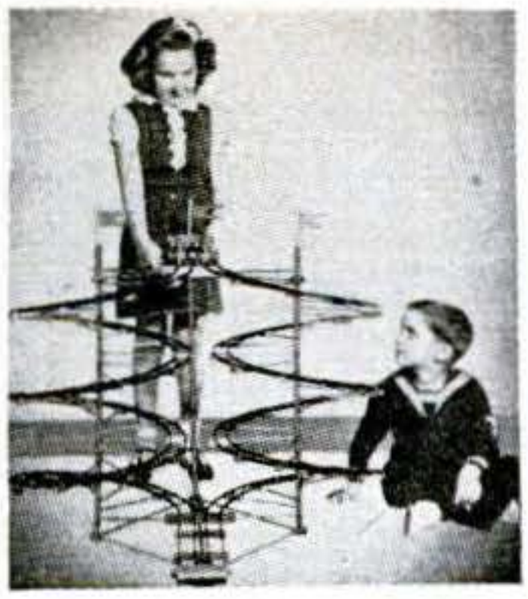

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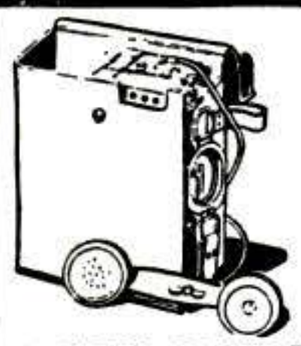

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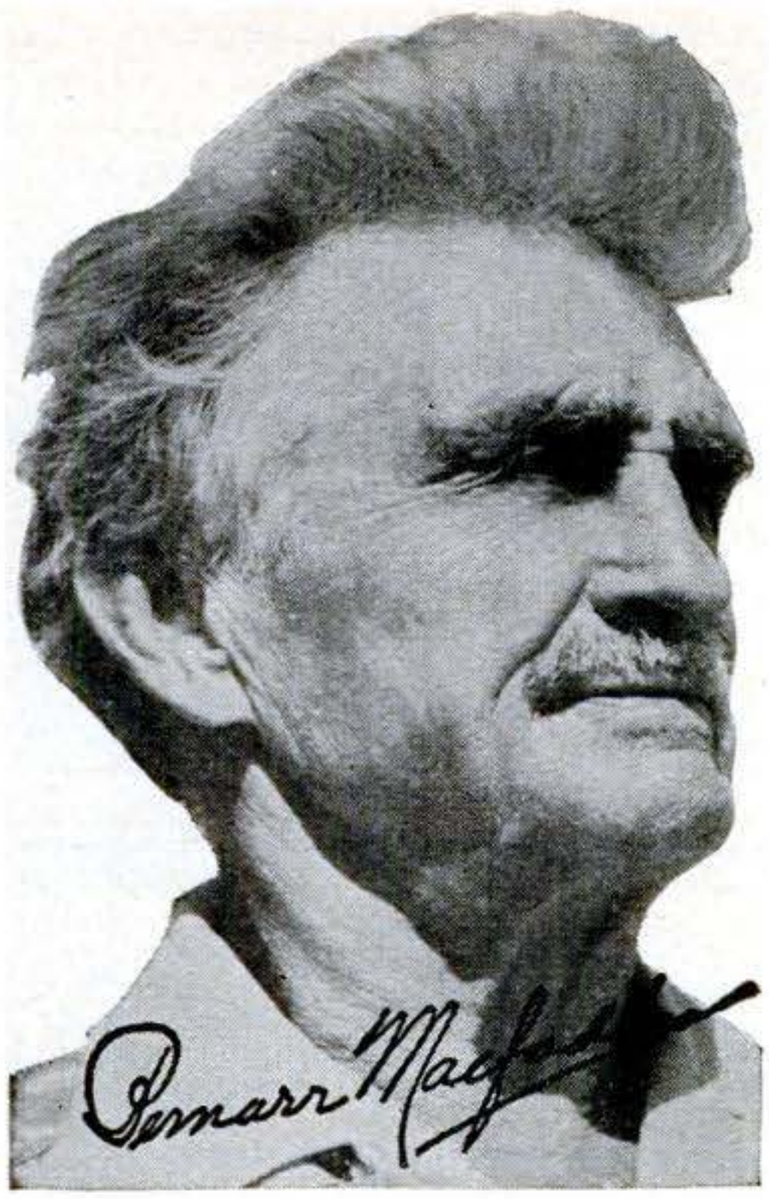

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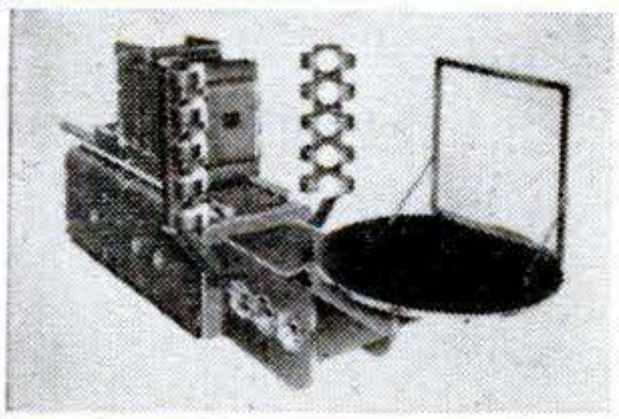

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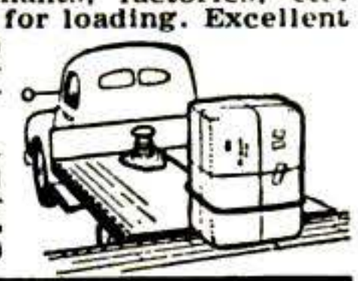

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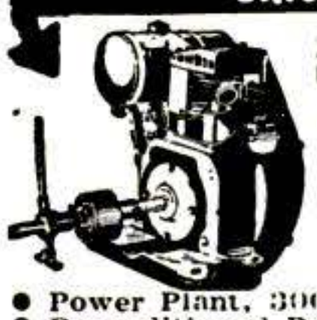

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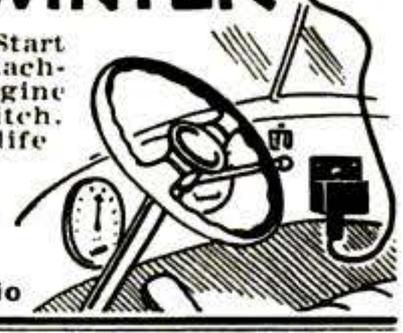

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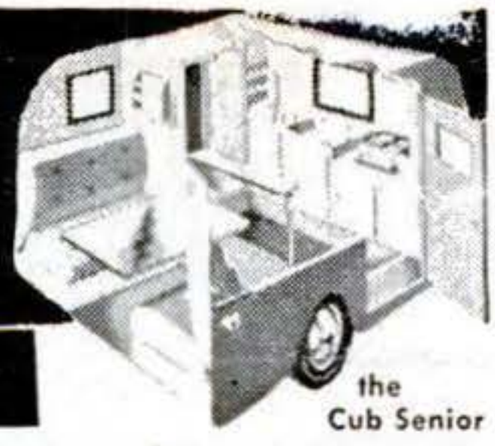
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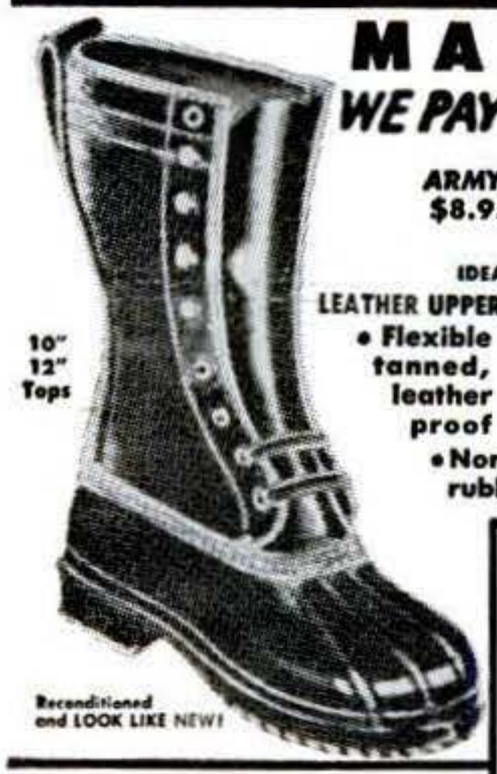

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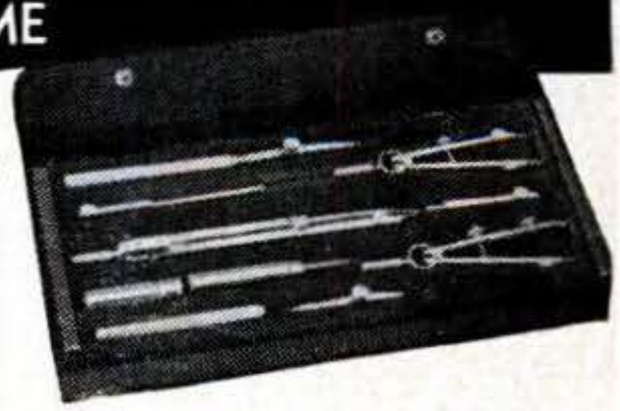

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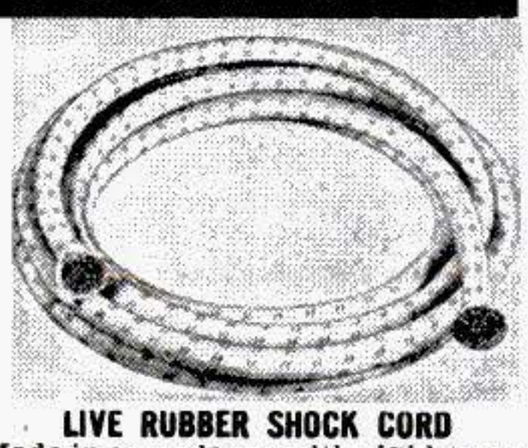

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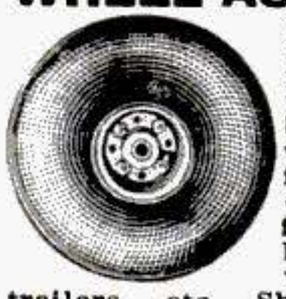

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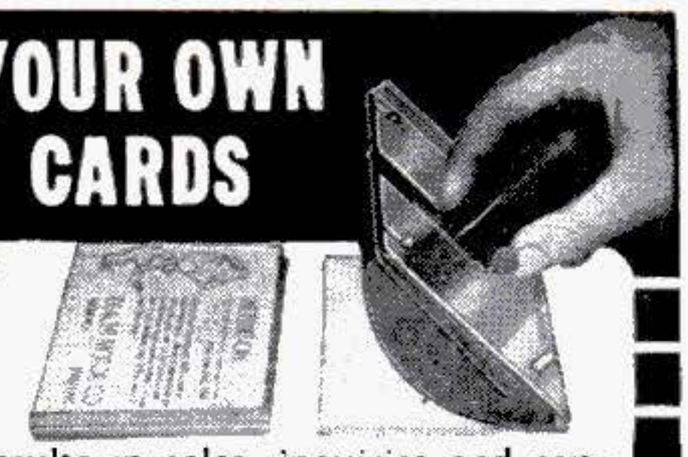

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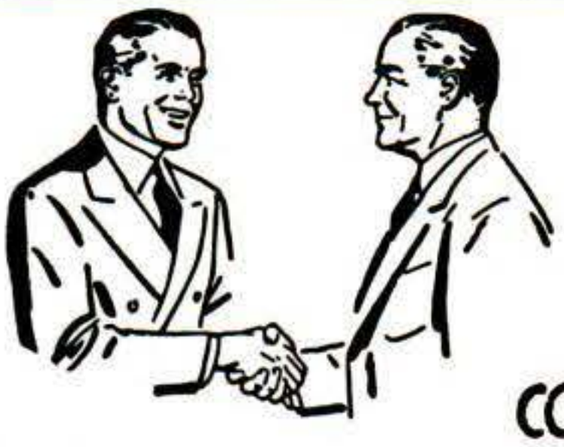

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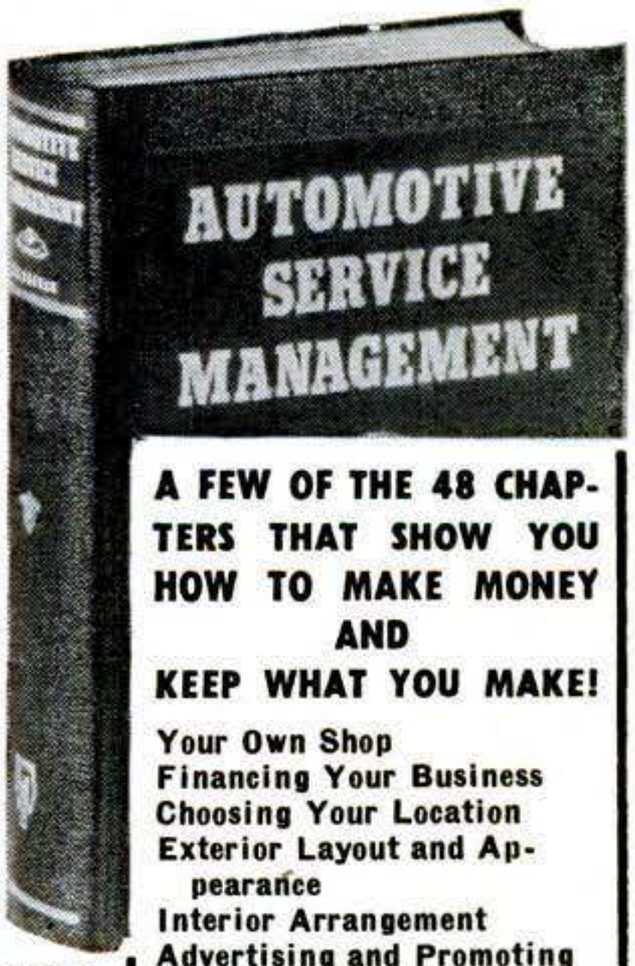

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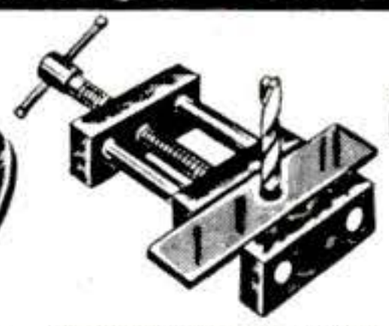

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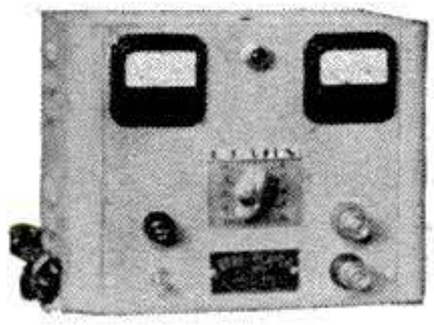

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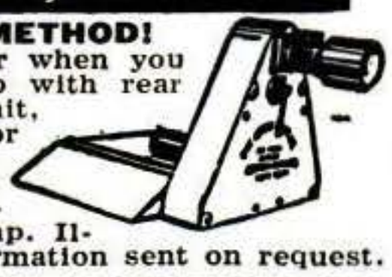

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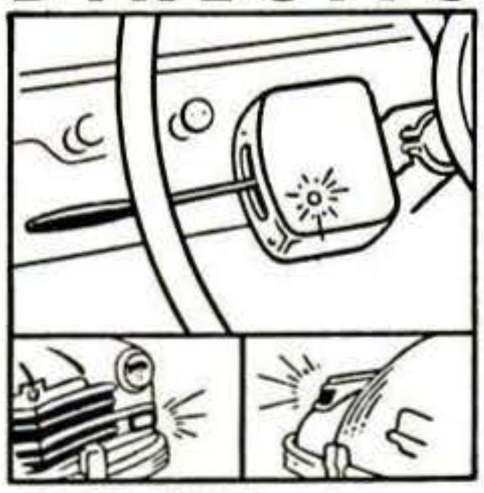

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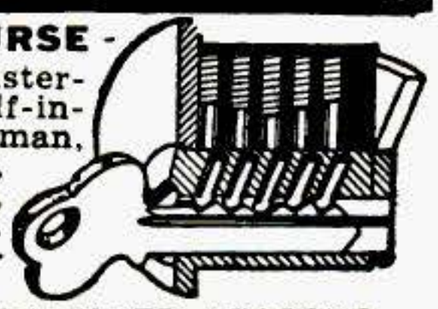

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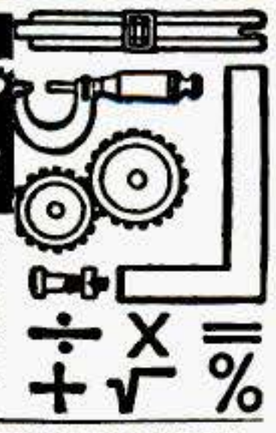

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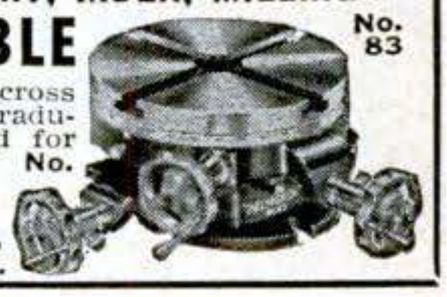

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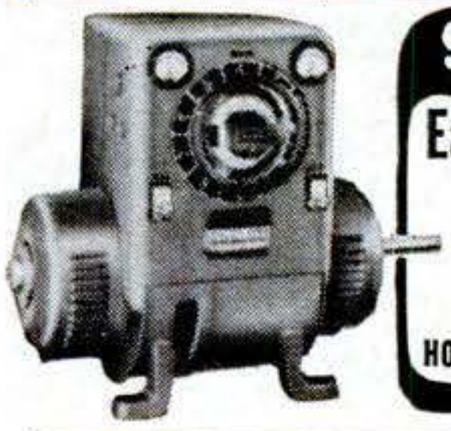

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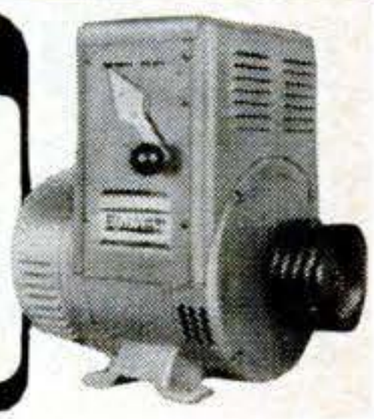

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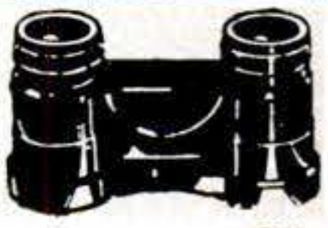

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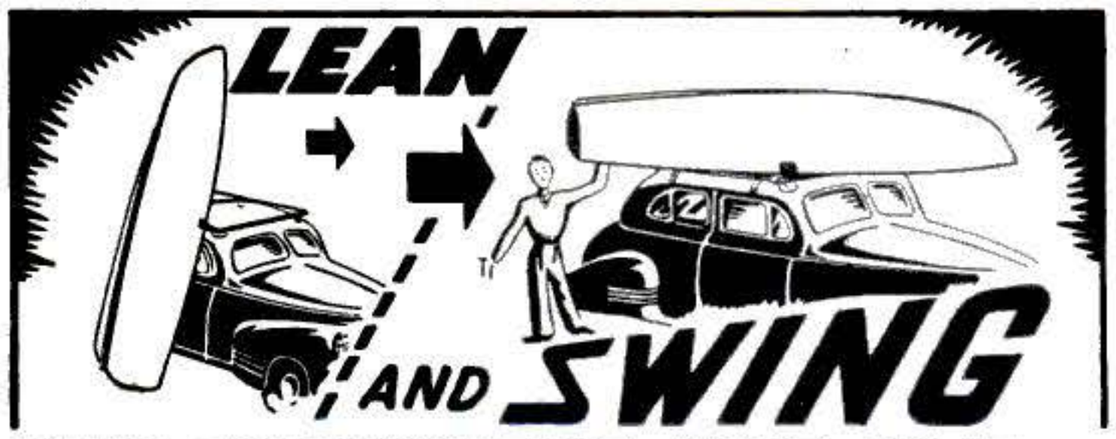

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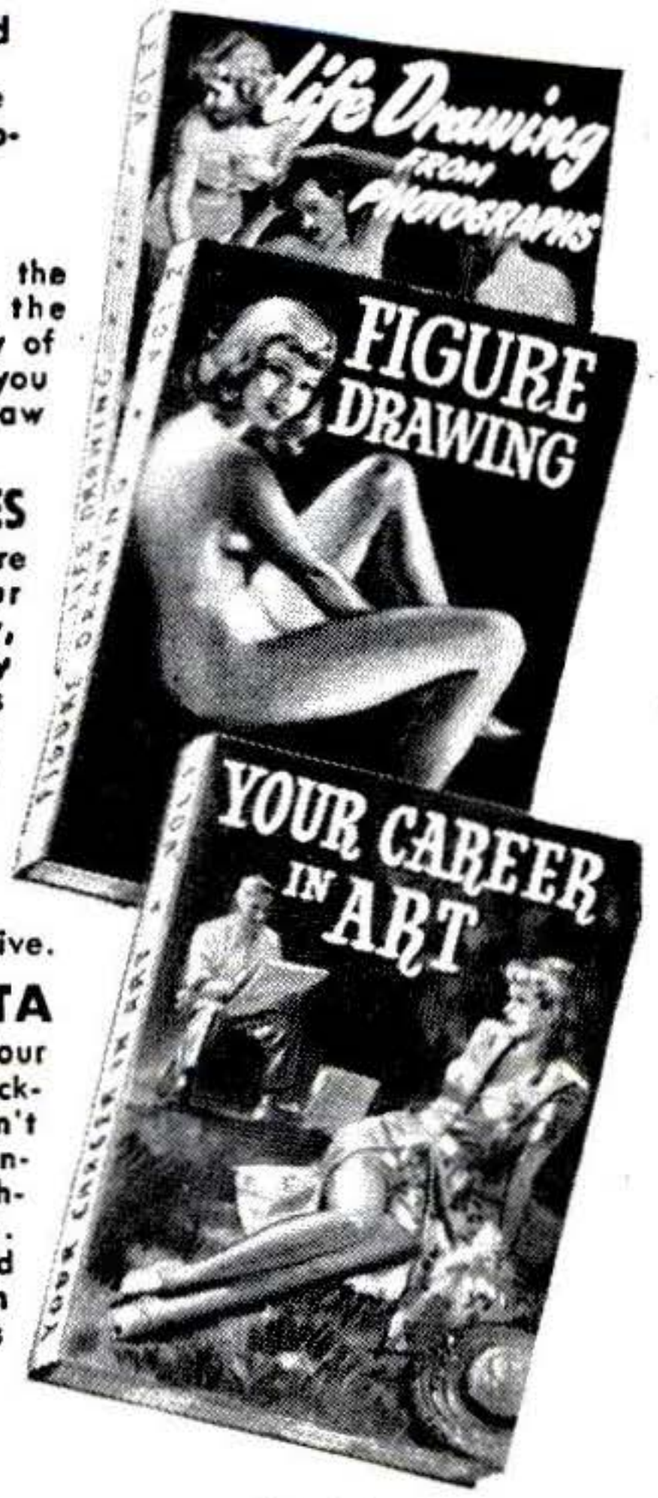

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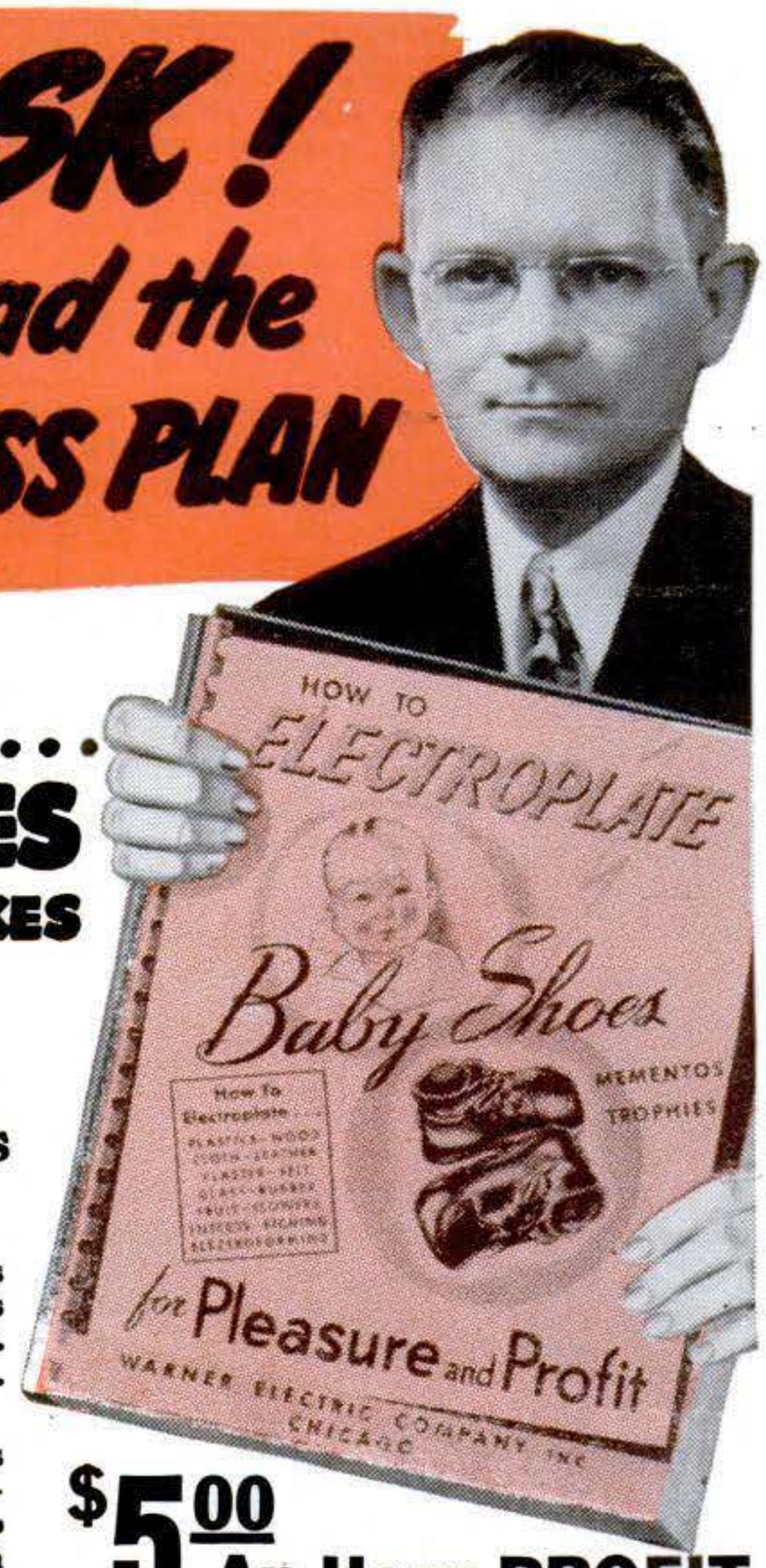

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SAVE Your Money! Million articles wholesale. Directory 25c. (Refundable). Publisher's, Box 1302-A9, Detroit 31.

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SAWDUST. Turn it into cash. Six methods. Instructions 25c. Charles, 12-FH, Norwood, Ohio.

BRONZING shows profits. Literature concerning equipment and process free. Luther Jones, Box 7283, Ft. Worth, Texas.

BIG Money Regraining-Refinishing Automobile Dashboards-Garnish Mouldings for Automobile Owners, Dealers, Body Shops. Profitable-Fascinating-Undeveloped Field. Full details. Write Outman, 4323 So. 38th, St. Louis 16.

EARN At home, casting novelties. Free course using latex molds. Major Chemical Co., 164 Portland St., Cambridge, Mass.

$46 FROM Square Foot Plywood; Jigsaw necessary. Write; Woodart, Bridgewater, Massachusetts.

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INVEST $1000—Make $5000 annually. Work 4 months. 25 franchises available. Veterans preferred. Ad-dea Co., Perkasie, Pennsylvania.

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WE can save you hundreds of dollars, yes, perhaps thousands, by subscribing to our dollar monthly, or $10.00 yearly plan giving you six best mail-order items every month, manufacturers lowest prices, profitable selling plans, and impressive literature. Mail-Items Analyst Institute, 126 Lexington Avenue, New York City, 16.

57 MONEY MAKING OPPORTUNITIES

NO selling, operate coin machines, amazing profits, details Free. Parkway Corporation, Dept. 18, 623 W. North Avenue, Baltimore 17, Maryland.

PROFIT with Larson Leathercraft. Belts, purses, 100 other ideas. Largest supply in U. S. Catalog 10c. Larson, Dept. C, 826 S. Tripp, Chicago 24.

LEARN Sewing Machine Repairing at home. Install our wholesale motor kits. Make $125 to $300 a week. Free particulars. Taylor Service Co., Hamilton PS, Ohio.

DETECTIVES Earn Big Money. Experience unnecessary. Particulars free. Wagoner, P-125, West 86th, N. Y., N. Y.

DOLLARFUL Idea$ for you Every Month in Advance—Voice Of Mail Order. Details Free. Advance Publishing Company, 313 East 21st Street, Suite 800, New York 10.

MAKE Money At Home—Cut grinding costs. Belsaw Powered Saw Gumming Machine precision Joints, Gums, Sharpens circular saws 8 to 48-in. diameter. Portable, fast, accurate. Catalog. Belsaw, 315-G Westport Rd., Kansas City, Missouri.

START profitable home business in spare time. Make extra money raising Golden Hamsters. Small, clean, odorless. New. Unlimited market. Literature free. Golden Gate Hamstery, 631-G Richmond Street, El Cerrito, California.

MAKE Money At Home as renewal headquarters for all magazines. Big profit in Christmas gift sales. Liberal commissions. Supplies furnished. Catalog Free. Write McGregor Magazine Agency, Dept. 519C, Mount Morris, Illinois.

SCHOOL Seniors—Earn 40% commission selling classmates America's Most Beautiful Graduation Name Cards. Largest selection. Outsells all others. Free sample kit. Printcraft, Dept. M, 1425 E. Elm Street, Scranton 5, Pa.

EARN Money Evenings, copying and duplicating comic cartoons for advertisers. Adservice, Argyle (2), Wisconsin.

15 MINUTES masters advertising and sign lettering, complete system; sign painters' secrets; cartooning book; all three, $1; free circular. Abenterprizes, Box 875-A, Peoria, Illinois.

FREE California land. Information 25c. Cowan, Box 561, Berkeley, California.

$50 WEEKLY while learning Watch-Clock Repairing. See ad page 40.

UNUSUAL Back Yard Money Making Opportunities! Fully Outlined! Pickett's, 62-P Sanders, Florence, Ky.

WOULD You pay 3%—first $350 made? Illustrated book "505 Odd, Successful Enterprises" free. Expect something odd! Pacific, Oceanside, Calif.

58 FORMULAS, PLANS, ETC.

FORMULAS—All kinds. Latest products. Literature free. Kemico, Park Ridge 15, Illinois.

10,000 FORMULAS and Trade Secrets. Free Literature. Stillmans, 555 Kingston Ave., Brooklyn 3, N. Y.

LABORATORY tested formulas. Lists free. Pont, Box 635-PS, Terre Haute, Ind.

FREE Formula Catalog. Anything Analyzed $20.00. Western Chemical, Salem, Oregon.

59 PLASTICS

LUCITE, Plexiglas. Any size sheets, masked. Square foot (12 x 12) cost. 1/16", 96c; 1/8", $1.25; 3/16", $1.52; 1/4", $1.80. Colors add 10%. Include 10% postage. Almac Plastics, 230 Fifth Avenue, New York 1, N. Y.

WHOLESALE Plastics supply catalog. 10c. Lucite, clear, colored. Metallic Acetate. Complete Castolite line, Phosphorescent, pearlizing pigments, dyes. Metal findings. Tools. Ideas—bargains galore. Fast delivery from stock. Gem-O'-Lite, Box 686K, North Hollywood, Calif.

INTERNAL carved roses, orchids, swans, goldfish, butterflies, etc. Jewelry and gifts. Crystal Floral Novelty Co., Bound Brook, New Jersey.

CASTING Plastics; Cold Curing Transparent and Colors. Information 10c. Box 3564, Cleveland 18, Ohio.

PLEXIGLAS Dome 1/8" x 30" diameter or 1/8" x 28" x 30" Sheet . . . $4.95 ea. Berger, 117 Market Street, Philadelphia 6, Pa.

PLASTIC supplies, materials, instructions for hobby or business. Send for free catalog. Tells about internal carving. Hays Plastics, 2333 Lincoln Avenue, Alameda, California.

PLASTIC, Sheets, Rods, Tubes, etc. Free List. Plastic Supply Co., 2901 N. Grand Blvd., St. Louis 7, Mo.

SPECIAL 1/4" 12"x12" Prime Plexiglas $1.75 include 10% Postage. Free Catalogue. Craft Plastics, Somerville, New Jersey.

FREE catalog — Plastic materials, cements, dyes, jewelry, findings and hobby supplies. Crescent Engineering, 1130 Fair Oaks, South Pasadena, Calif.

PLEXIGLAS—Write for Free Price List. The Unique Glass Shop, 309 Cowardin Ave., Richmond, Virginia.

"LINO-Plastic". World's finest liquid plastic surface coating. Easily applied, brush or spray, dries in 20 minutes. Beautiful, transparent, wear resistant finish for Gunstocks, Trophies, Models, Toys, Tennis Racquets, Bartops, Novelties, Floors, Desks, Wood Paneling, Fishing Tackle, Golf Clubs, Etc. Quart $2.49 postpaid. Agents wanted for this sensational product. Good earnings. Plastic Products, 209 S. Oak St., Ottawa, Ohio.

60 CHEMICALS AND APPARATUS

NEW Idea Chemical and Apparatus Outfits for Home Experimenting. Photo-Scales, Microscopes, Chemicals, Biological and Laboratory Supplies in Small Quantities. Catalog 15c. Established 1931. John H. Winn, 124-B West 23rd Street, New York, N. Y.

NEW Laboratory supply catalog of Chemicals and Apparatus. Contains many thousands of items with illustrations. Send 25c. Standard Science Supply Company, 1232 N. Paulina St., Chicago 22.

NEW catalog: Chemistry, mineralogy, biology, physics 10c. Tracey Laboratories, Evanston, Ill.

HANDBOOK for Chemical Experimenters, illustrated, hundreds of experiments, 50c. Experiment booklet, 15c. Reading Scientific Co., Reading, Pa.

SUPPLIES, books. Catalog 10c. Atlantic Laboratory Supply, 21 Wenham, Boston, JP, Mass.

LUMINOUS Paints will glow in dark. Six colors. Fairmount Chemical Co., 136 Liberty St., New York City 6.

CHEMICALS and apparatus for industrial, analytical, and private laboratories. Catalog 15c. Dept. M-26, Biological Supply Co., 1176 Mt. Hope Ave., Rochester 7, N. Y.

61 HELP WANTED

BOYS Wanted. Over $2.00 hour! Sell name plates for front doors. Free Sample. Write Dept. 70, National Engravers, 214 Summer, Boston, Mass.

ALASKA. The Last Frontier offers unlimited opportunities. $1 brings government map and Directory listing firms in Fishing, Construction, Mining, Aviation, Fish & Game rules, Homestead data. Alaska Opportunist, Box 883-S, Hollywood 28, Calif.

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FOREIGN Employment?? List of Overseas projects with application form. $1.00 Cash (C.O.D. $1.32). Foreign Service Institute, Box 3980, Miami 24-A, Florida.

TEACHERS! Choice Positions (through) Kilander Teachers' Agency, Box 114A, Rosslyn Station, Arlington, Virginia. Free Registration.

62 AGENTS WANTED

GOOD Paying Business Silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures, etc., by late method. No tanks or shop required, outfit furnished. Free Booklet. Gunmetal Co., Ave. G, Decatur, Illinois.

EXCELLENT Sideline for printing and advertising salesmen. Decalcomania name plates in small quantities. Great demand. Also, make money with our line of Automobile Initials and Sign Letters. Free Samples. "Ralco", XL-Roxbury, Boston 19, Mass.

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PHOTO-Salesmen-Agents. Sell beautiful hand-colored plastic enlargements. Collect deposit, we deliver. Profitable sideline. Send card for free sample kit. Novel Portrait Co., 3343-A North Ave., Chicago, Ill.

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BE first! Clean up selling brilliant new. metal Christmas cards featured in America's greatest box assortment line. Special metal. plastic. foil and novelty assortments. Five portfolios of personal cards. Fast imprint service. Free samples. Elmcraft Chicago. 5930 South Western. Chicago 36. Ill.

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AMAZING offer—$40 is yours for selling only 50 boxes Christmas cards. Also 50 and 25 for $1.00 with or without name. Free samples. Other boxes on approval. including entirely new. different deluxe assortment with feature television card. Cute plastic assortments. Write today. It costs nothing to try. Cheerful Card Co.. 912 White Plains. New York.

A DRESS Yours with every 3 you order for yourself and family. Amazing new bonus plan. Everything Free. Harford Frocks. Dept. A-435. Cincinnati. Ohio.

SHINE Shoes Without "Polish". New Invention. Lightning seller. Shoes gleam like mirror. Samples sent on trial. Kristee 133. Akron. Ohio.

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MAKE money easily. New spare time plan. Up to 100% profit. No experience. Show unusual Christmas. Everyday card assortments. Plastics. Gleam and Glo. Kiddies Cards. Wrappings. Attractive Gift items. Bonus. Special offers. Send today for free samples 30 different Christmas cards with name. 50 for $1.00 up. Stationery. Coasters. Thomas Terry Studios. 101 Union Ave.. Westfield. Mass.

EARN Extra Money easily. sell new Christmas cards and Gifts-'n-Things. 21 folder Ass't sells for $1.00. sent on approval; no investment. Get $50 or more selling only 100 boxes. Amazing Sample Offers. Headquarters for new 3-dimension Christmas Cards. Plastics. genuine engraved etchings. We send Free Samples of easy-to-sell personal Christmas cards and stationery. Pen-'n-Brush Studios. Dept. PS-9. 139 Duane St.. N. Y. 13. N. Y.

FREE Nylons given if Kendex hosiery runs or snags. World's only women's hosiery sold with written guarantee amazing everybody. Mere words could not express unbelievable money making opportunity. Fantastic earnings become reality. Armstrong earned $202 in 9 days. Watkins sent 92 orders in one day. Imagine replacing hosiery free regardless of cause—whether use or abuse! Truly sales dynamite for terrific profits. Even if you never sold before. three magic words: "Guaranteed Against Everything" will open doors for you—make women listen and pour money in your pocket. Nationally advertised in Life. Ladies Home Journal. Saturday Evening Post. McCalls and Woman's Home Companion. Awarded Seal of Approval by Good Housekeeping. 75 million readers will see Kendex advertising to help you make quick sales and big money. Complete line from sheerest 15 denier 51 gauge to heavy 70 denier service. Sizes 8½ to 11½; lengths 28 to 35 inches; latest fashion colors plus white; full fashioned seamed and seamless. No competition because Kendex nylons are not sold in stores. Also complete line men's hosiery actually guaranteed for one full year or replaced free. Nothing like this anywhere. Includes rayon. nylon. lisle. wool. cotton. mixtures. etc. All styles. patterns. colors. prices to please everybody. 200.000 pairs constantly in stock for fast delivery. Thousands shipped daily. Over 30 years in business. You need no money or experience. Nothing to pay now or later. Just show free outfits. Write orders. We deliver and collect. Big advance cash plus huge bonus. Earn money spare or full time —exclusively or as side line. No restrictions. Become manager—appoint others to sell for you—earn steady income on their sales. Man or woman. young or old. experienced or beginner. you can make money and friends writing orders. Everything you need is furnished free. including sales books in color. samples of hosiery materials etc. Simply write your name and address on postcard and make money next week with money-making outfits sent free and prepaid. No obligation. Kendex Company. Babylon 94. New York.

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STOP! Want to make money all year round selling a complete line. Wool and Cotton Embroidered Uniforms for summer and winter wear. uniform trousers. shirts. caps. ties. badges. 2000 emblems. personal initialed buckles. belts. and hundreds of other easy-to-sell items. Sales Kit furnished. Please write today. Hook-Fast Company. Box 480 PS. Roanoke. Va.

FREE! Big box actual full-size packages groceries. home needs. sent Free F.O.B. factory. Try them at home and show friends. World-beating money-making opportunity. Write Zanol. Dept. 7091-K. Richmond St.. Cincinnati 3. Ohio.

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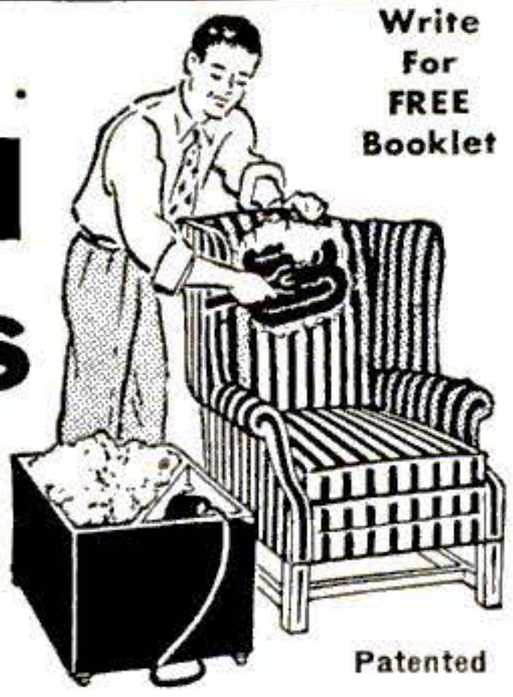

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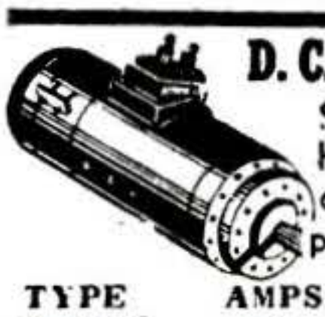

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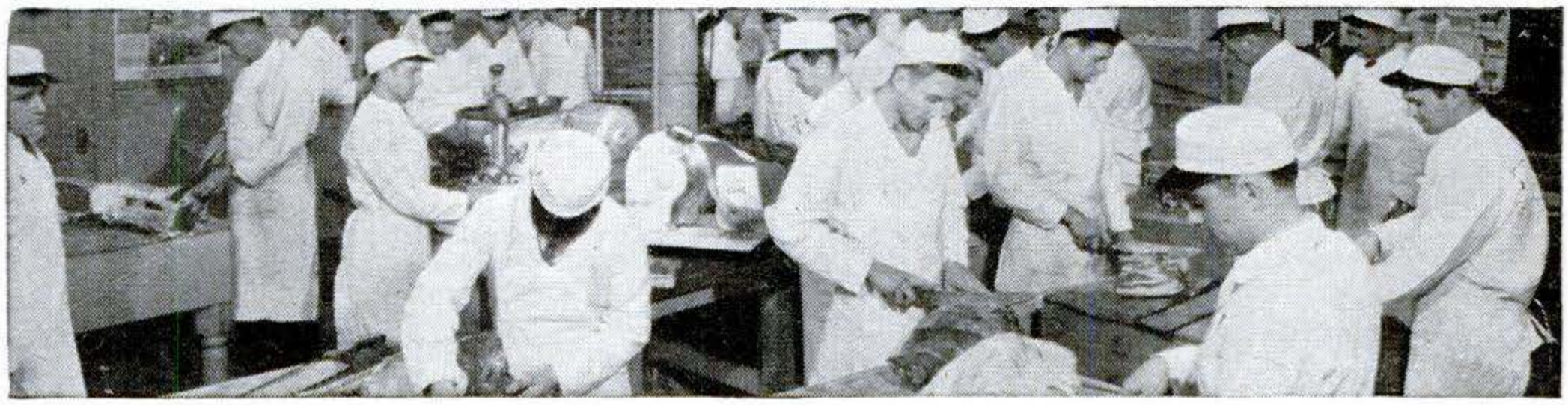

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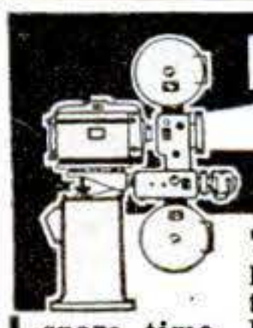

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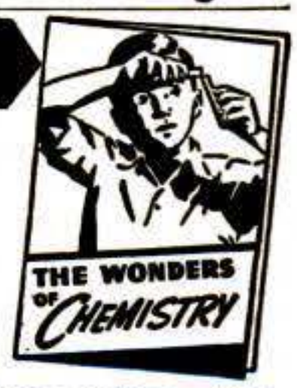

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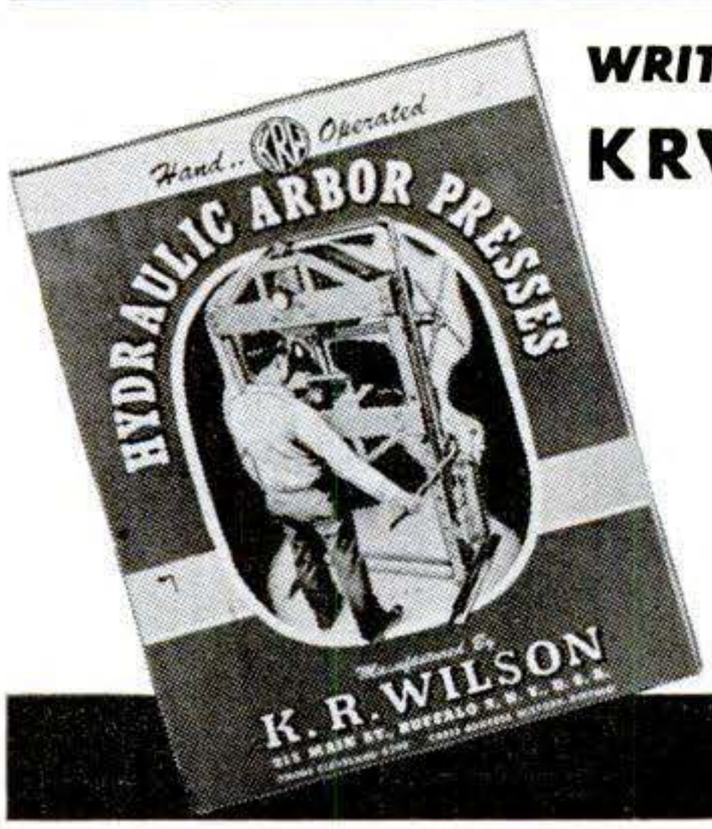

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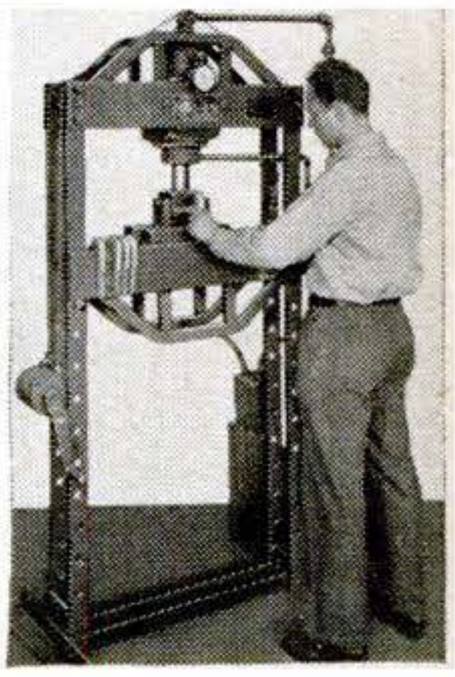

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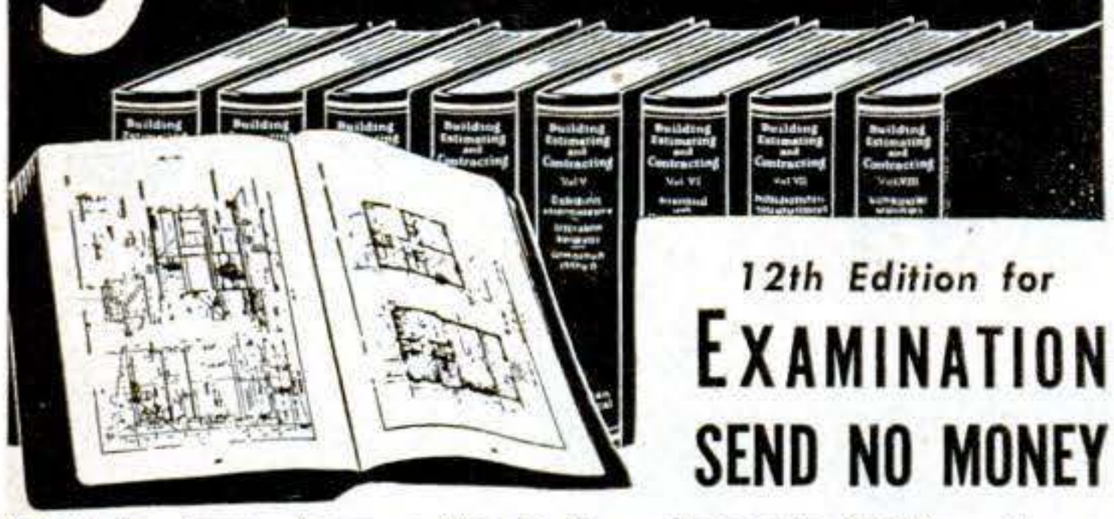

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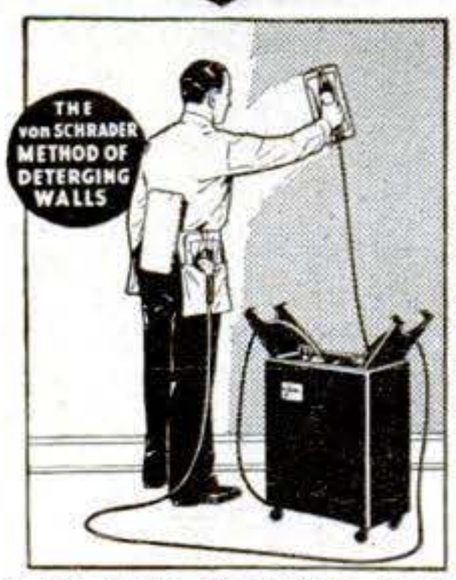

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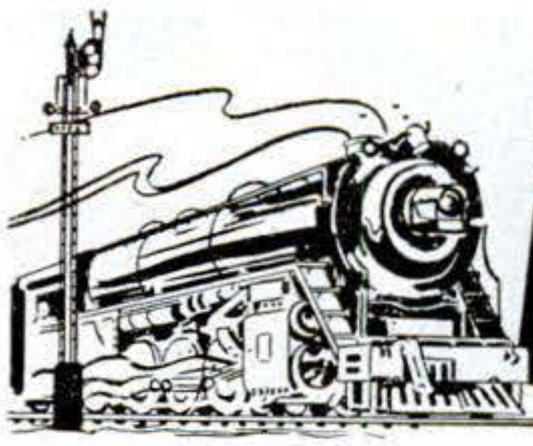

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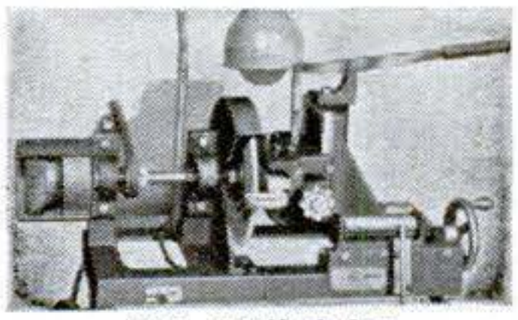

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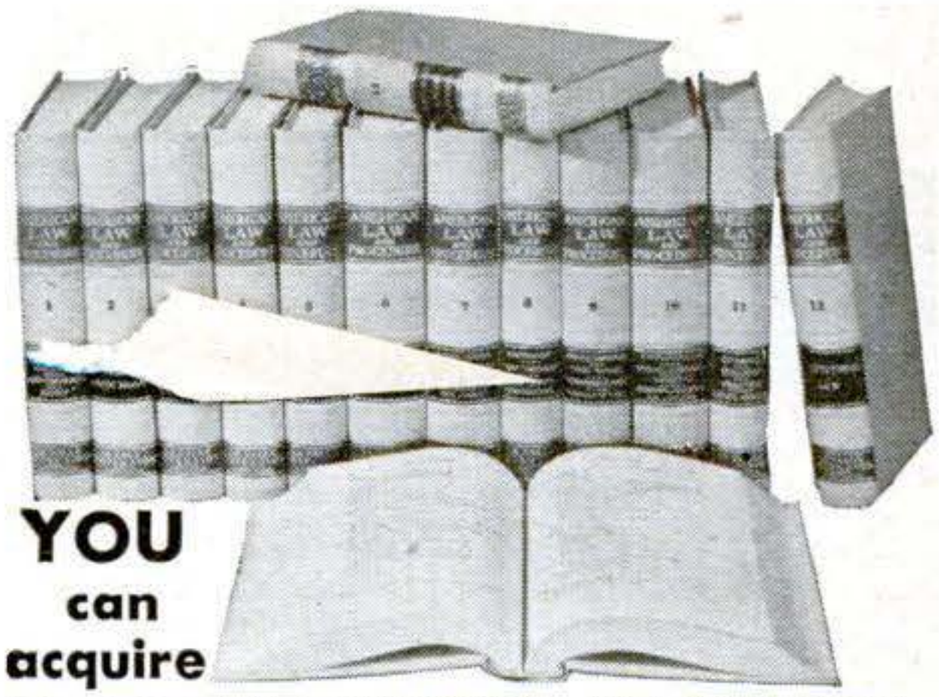

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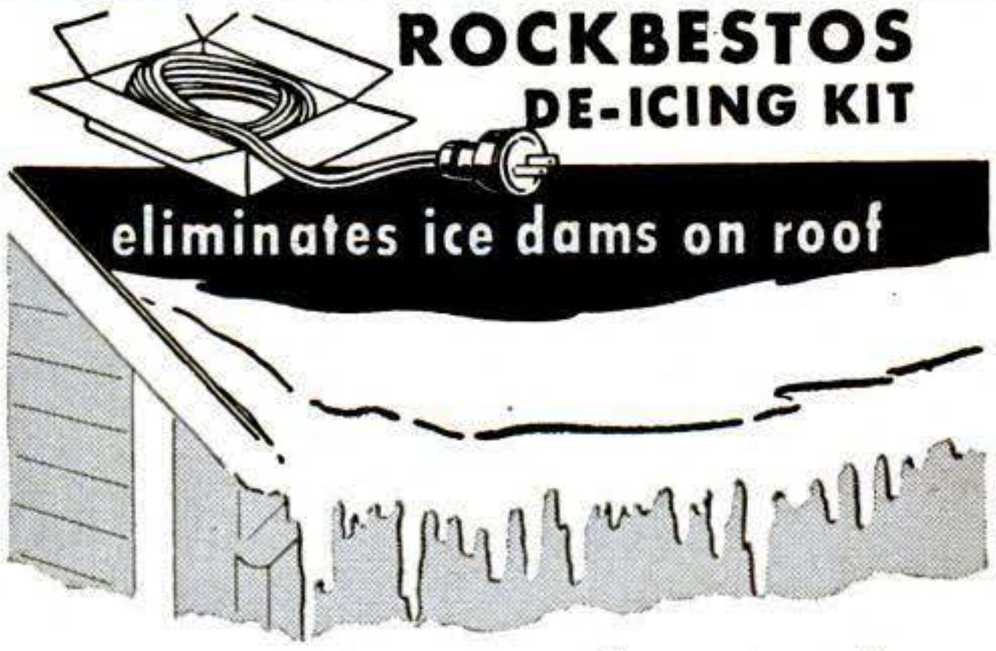

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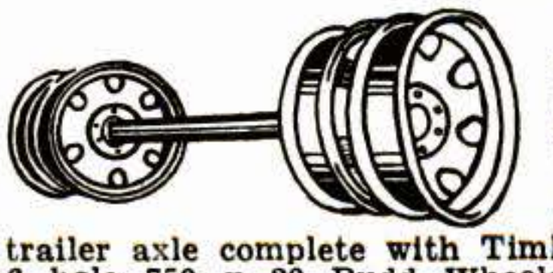

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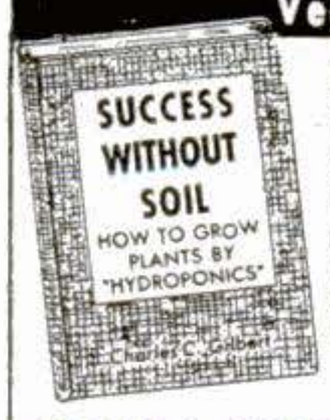

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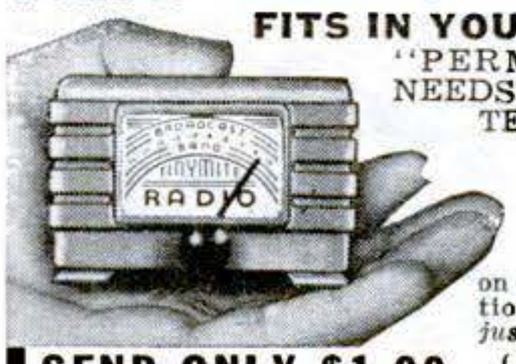

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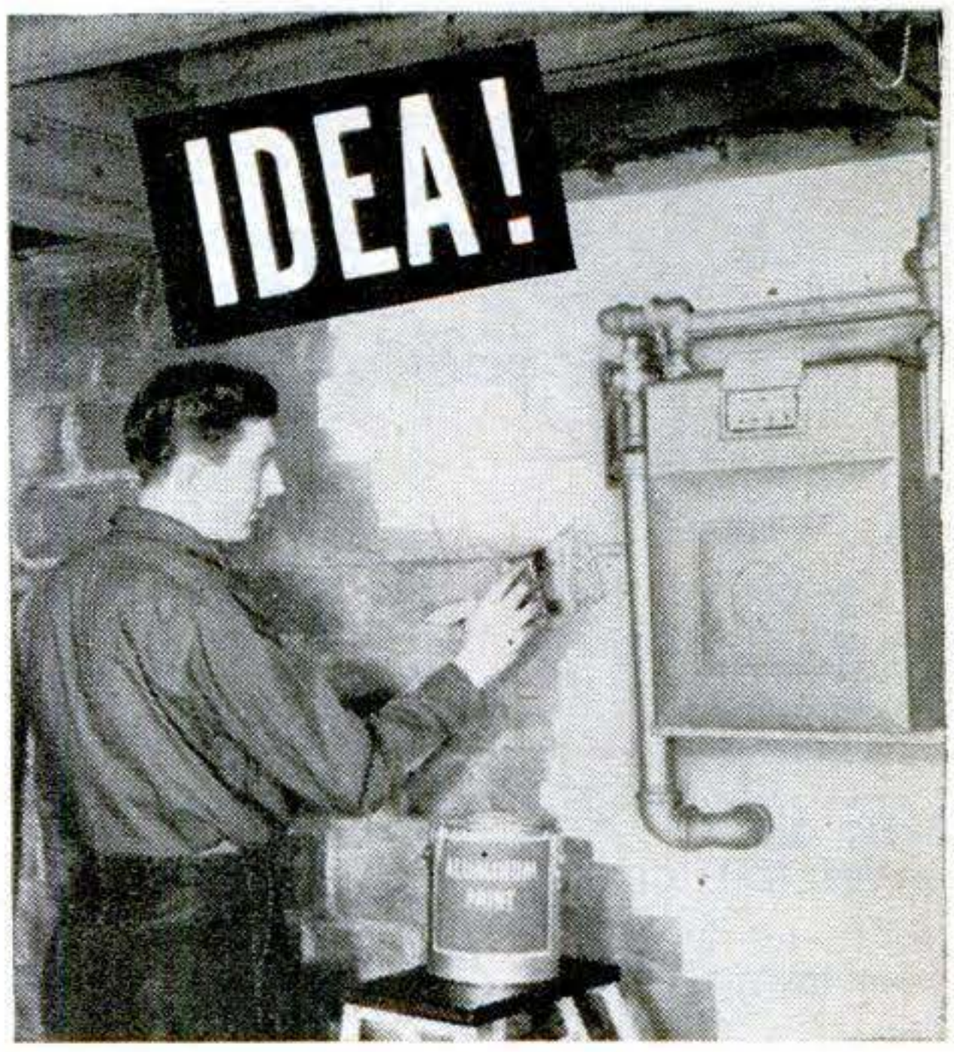

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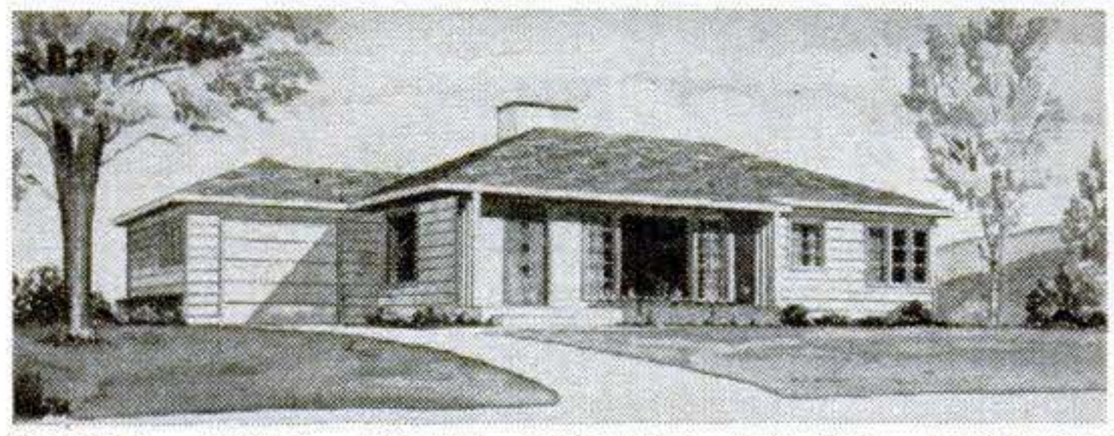

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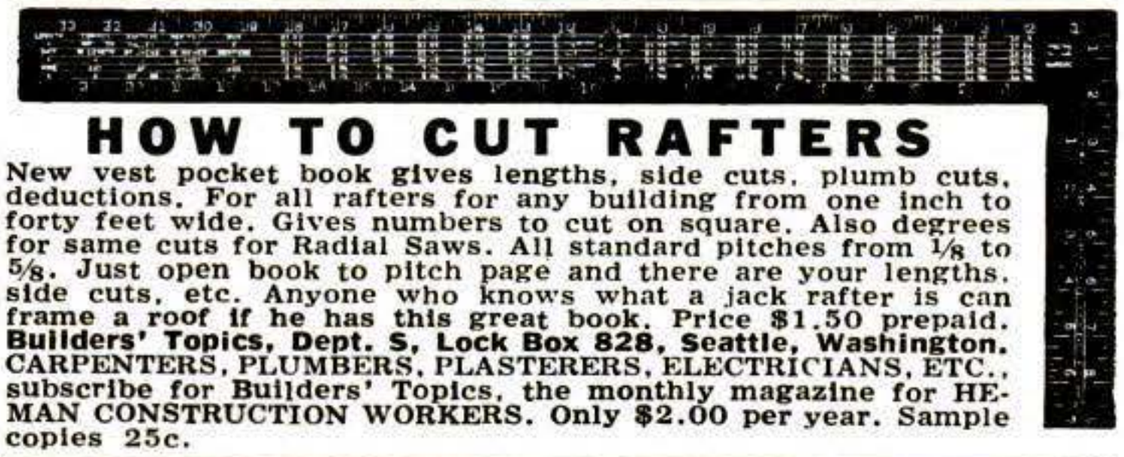

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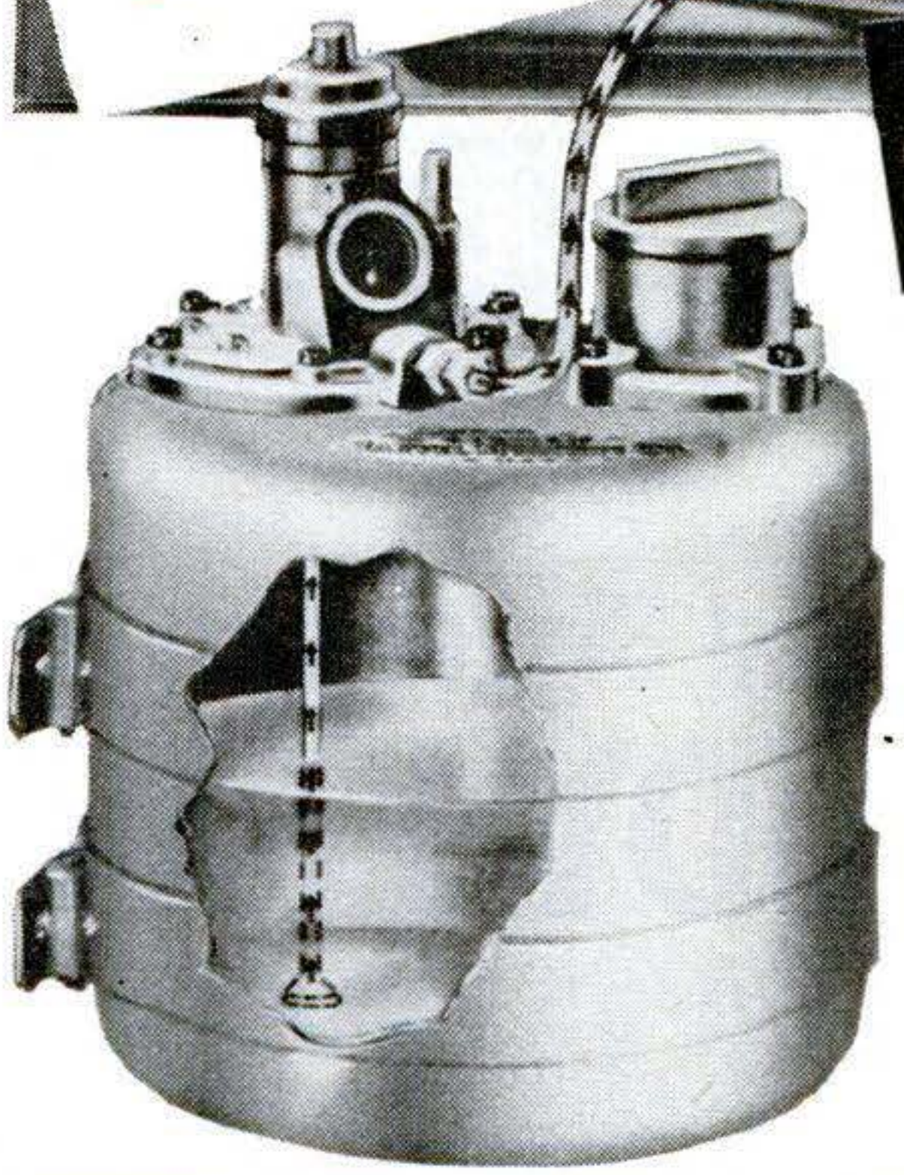

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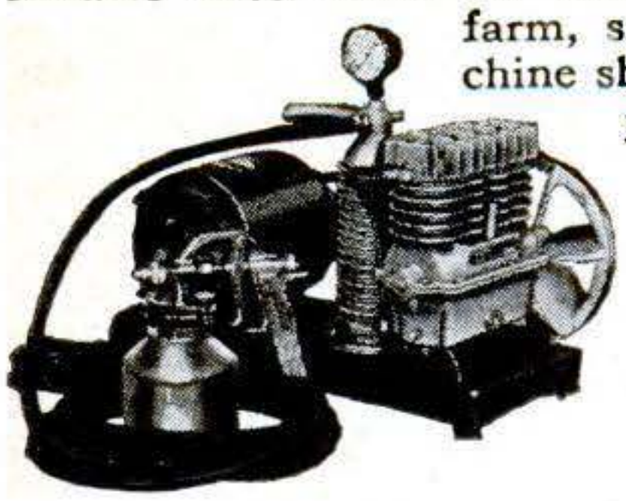

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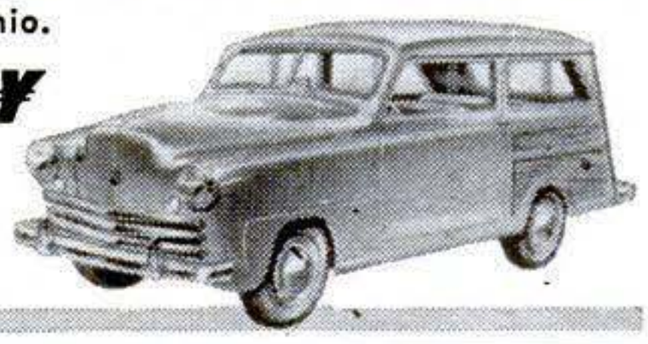

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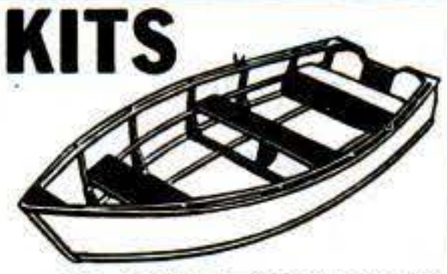

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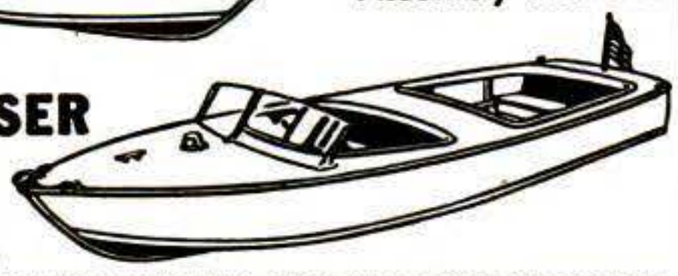

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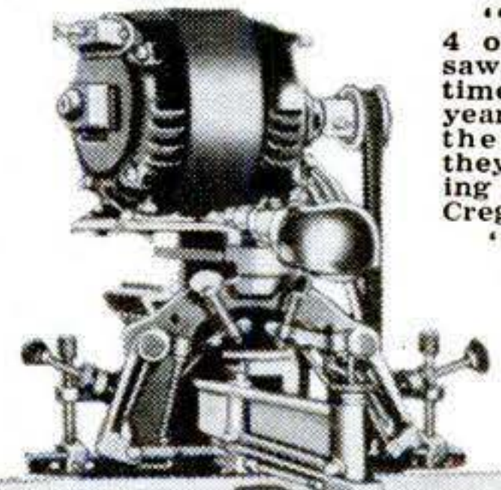

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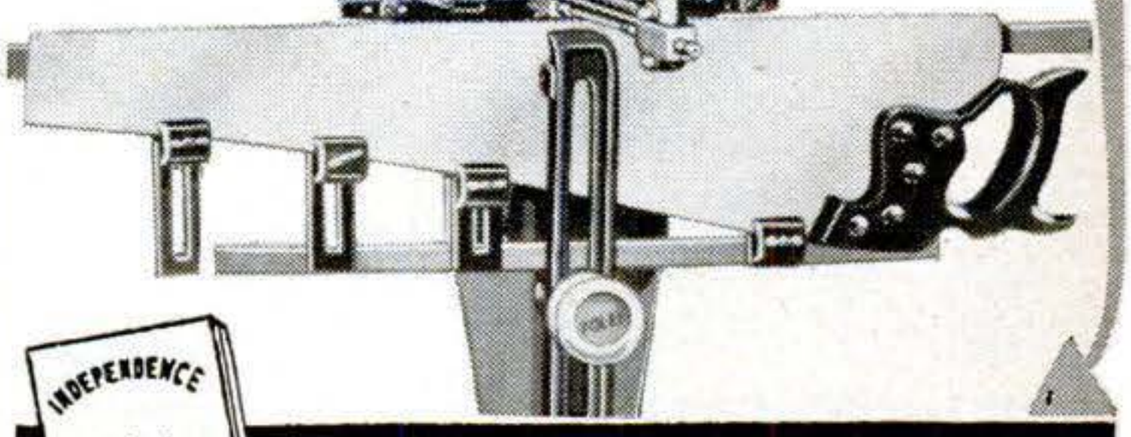
"Have filed over 2200 saws in 18 months. One customer always brings another." E. A. Fink



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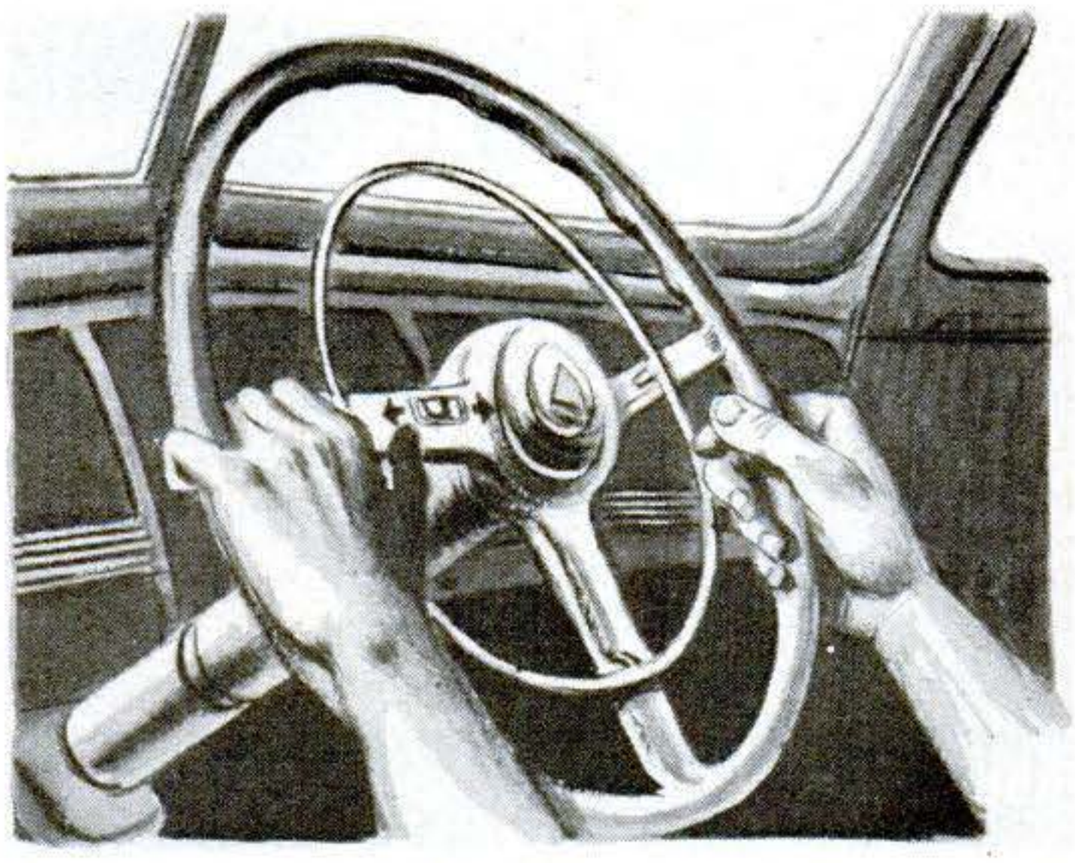
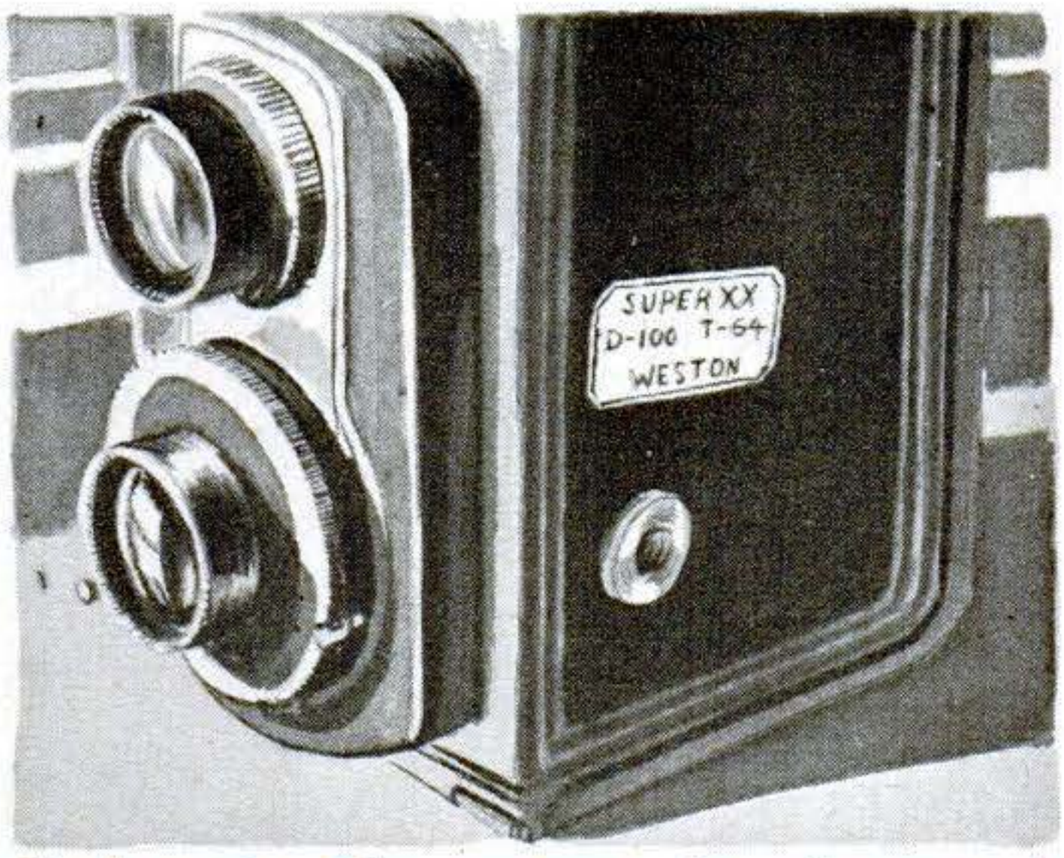


Simpler controls for direction lights. Instead of the control arm beneath the steering wheel, why not have a button set in the cross arm so it could be reached with a thumb?—*Jack Gehring, Watertown, N. Y.*



Markers in film cartons. An adhesive tab with the type of film and speeds printed on it could be stuck to the camera to remind the photographer what film he was using—*E. B. Geisendorff, Jr., San Antonio, Tex.*

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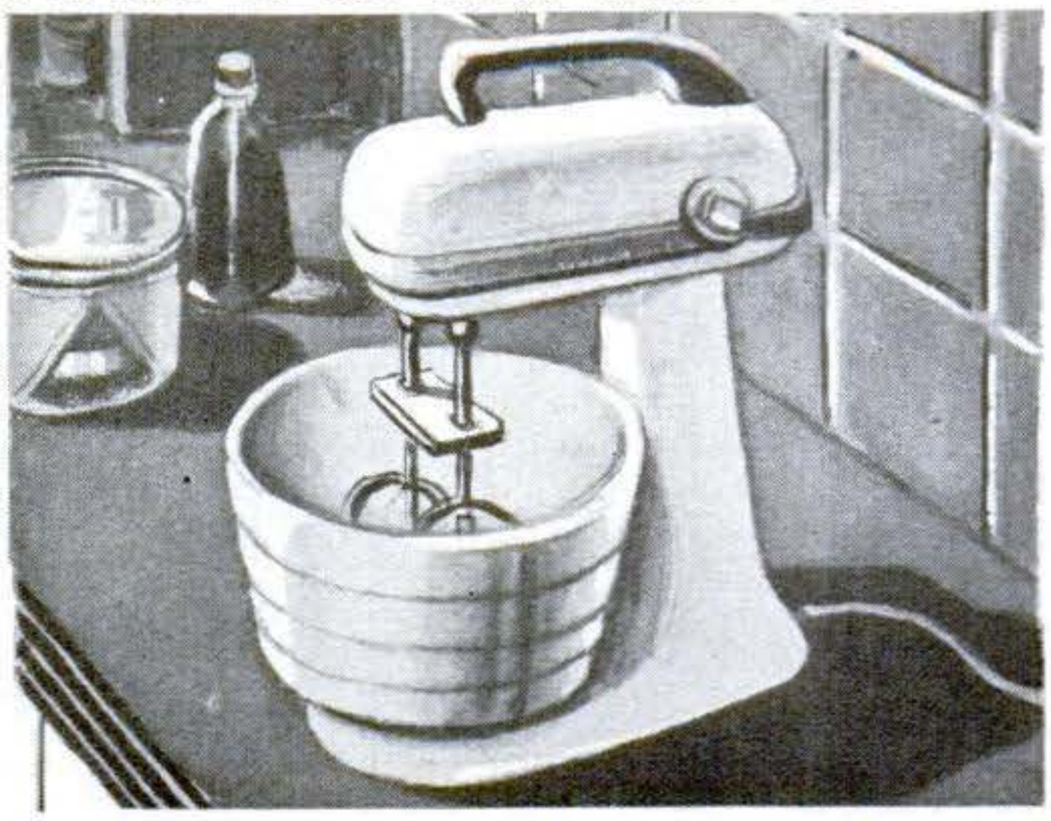
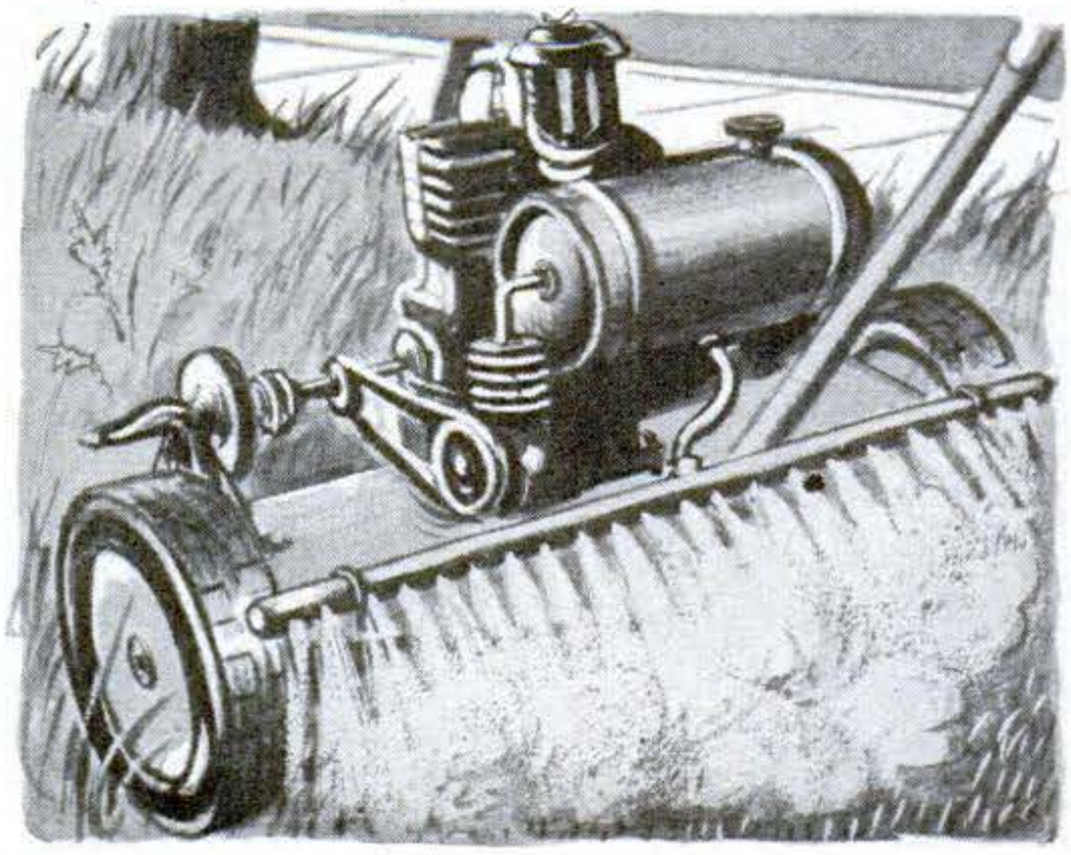
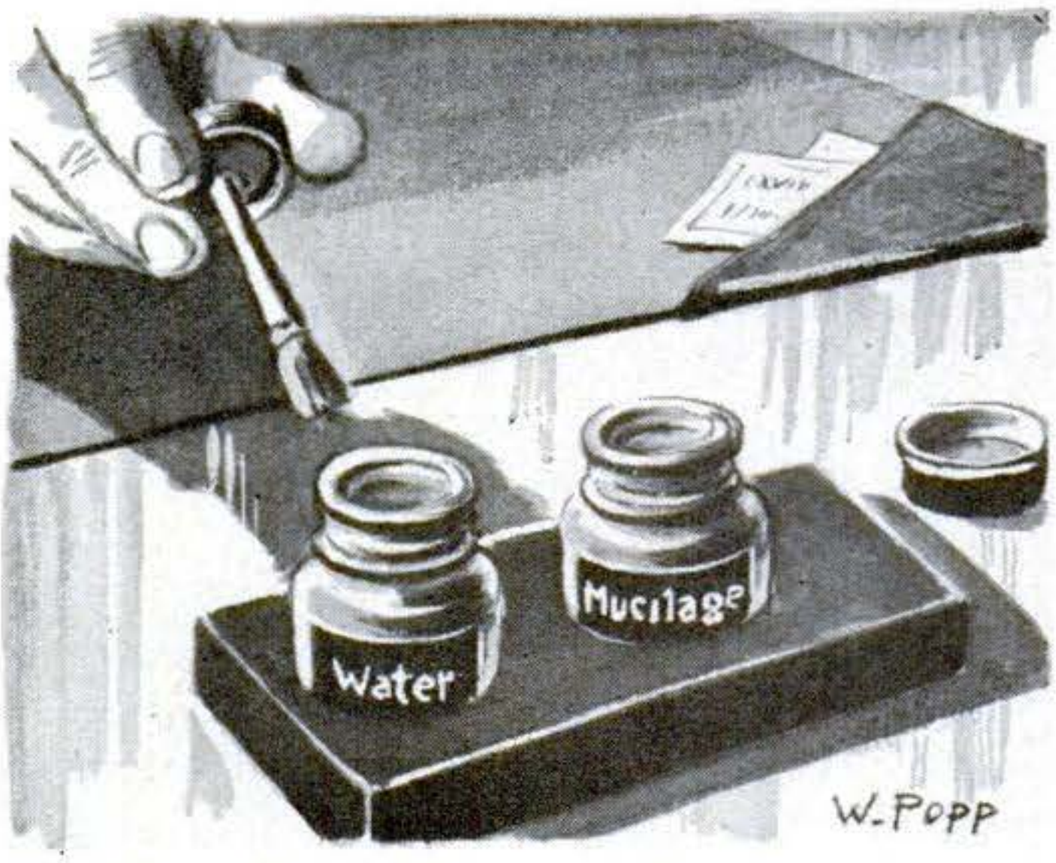
I'd like to see them make . . .



Guards on electric mixers. A simple metal guard on the shanks would prevent heavy dough—such as cookie mix—from riding up the shanks of the beaters.—*Mrs. Leonard Halvorson, Lake Stevens, Wash.*



Detachable weed sprayers for power lawn mowers. This could be a tank and a small compressor belt-powered by the mower's engine. It would save going over a lawn twice. —*Mrs. Melvin Witte, Wheatland, Ia.*



Double-well mucilage stands. One container would hold the mucilage and the other would hold water, both for convenience in thinning the adhesive and for cleaning or softening the brush.—*Frank F. Rade, Detroit, Mich.*

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The car that likes to be compared

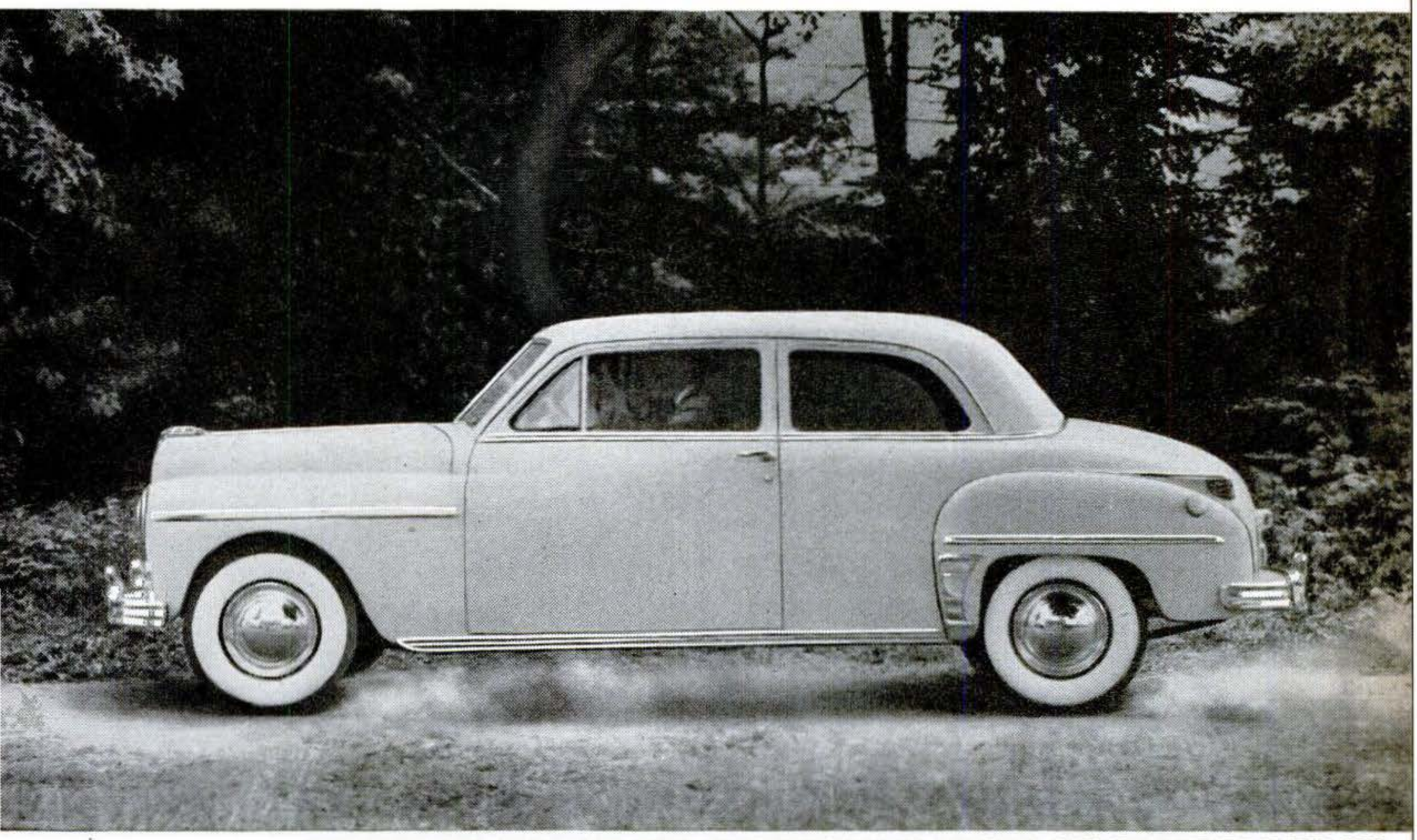
NEW

PLYMOUTH

Yes, it likes to be compared in ACTION, too!

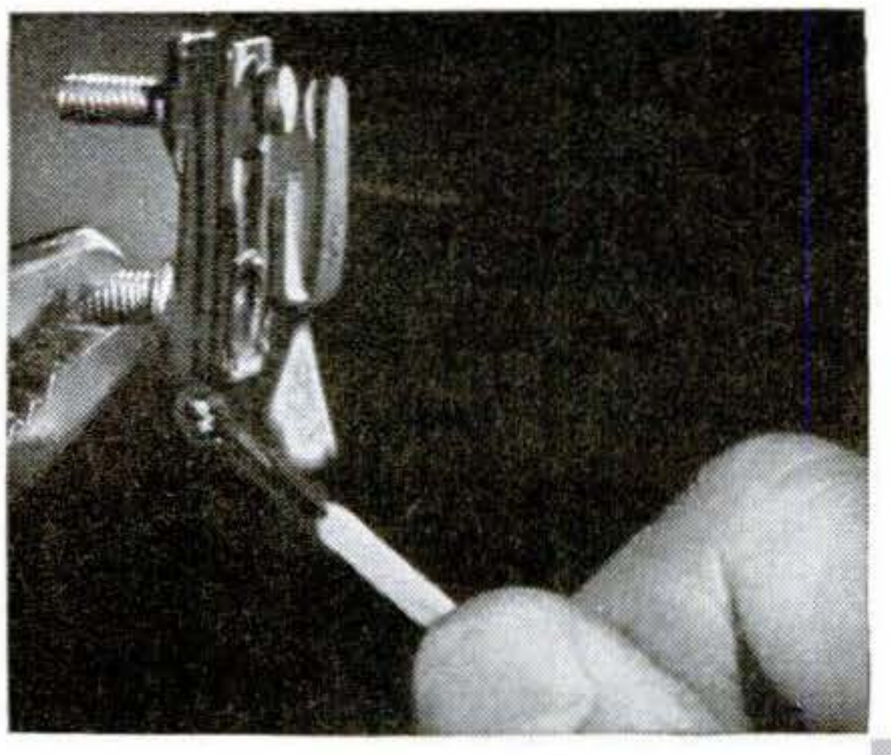
NERVE center of Plymouth convenience is the new ignition key starting. Turn the key—the engine starts! Only Plymouth, in the lowest-priced field, has this feature.

MUSCLES are huskier. New cylinder head with a compression ratio of 7 to 1 (highest of the leading lowest-priced cars) squeezes more performance from the fuel.



WHITE SIDEWALL TIRES, CHROME WHEEL COVERS, REAR BUMPER GUARDS AND REAR FENDER SCUFF GUARDS OPTIONAL AT EXTRA COST

BODY beautiful and *practical*, too! Although the new Plymouth illustrated here has a longer wheelbase, the over-all outside length is less. It's an easier car to park and handle.

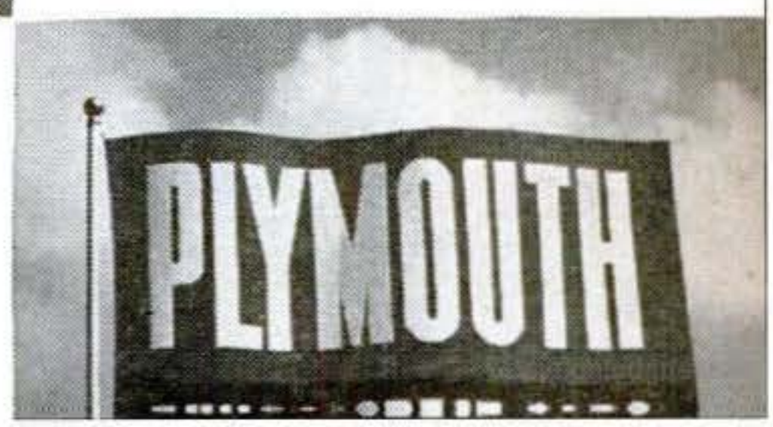


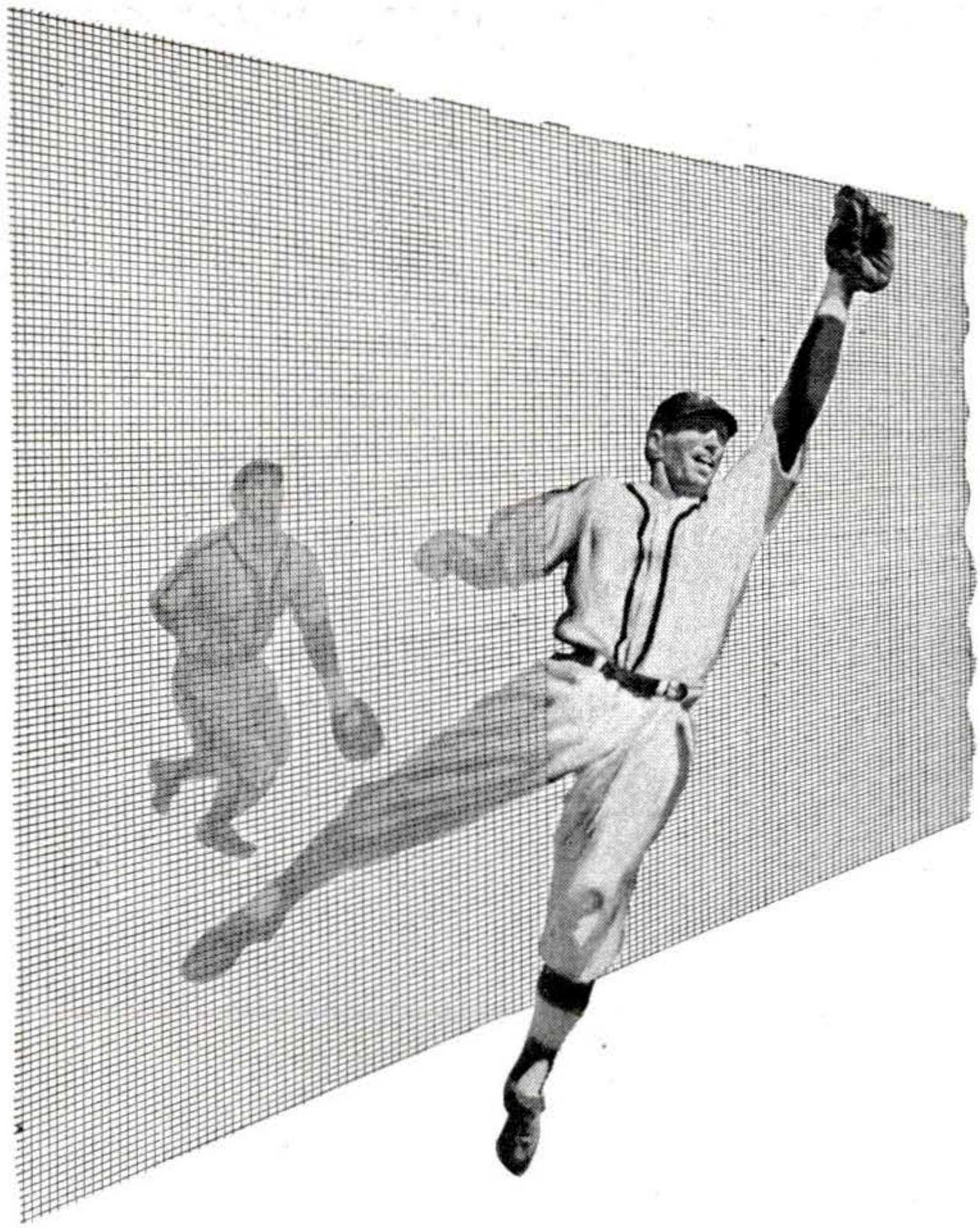
THUMB on the circuits is held by this great little firewarden. Heat from a "short" makes it lift and break the circuit until the trouble has gone. No more replacing of fuses!

CHECK ✓

the new Quality Chart at your Plymouth dealer's. Compare the three leading lowest-priced cars. Then drive the great new Plymouth and let the ride decide!

PLYMOUTH Division of CHRYSLER CORPORATION, Detroit 31, Michigan





RCA Laboratories developed a copper mesh with 2,250,000 tiny openings to the square inch for the television camera "eye."

You get ***finer television pictures*** *through this super-fine mesh*

In RCA Image Orthicon television cameras you will find a super-fine copper mesh. Until a new technique for making this type of screen was discovered at RCA Laboratories, only coarse and irregular mesh—which obstructed 60% of the picture—was available.

Today, through RCA research, such mesh can be made with 1500 gossamer wires to the linear inch. An ordinary pinhead will cover about 7000 of its tiny openings.

By RCA's technique—now producing commercial quantities of 200- and 500-mesh screens—the mesh is so fine, so regular in structure, that it is invisible on home television receivers . . . and as much as 85% more television picture passes through.

You benefit—many times

This new type of super-fine wire mesh, like most major developments in all-electronic television, is another RCA Laboratories *first*. Leadership in science and engineering adds *value beyond price* to any product or service of RCA and RCA Victor.

* * *

The newest developments in radio, television, and electronics may be seen in action at RCA Exhibition Hall, 36 West 49th Street, N. Y. Admission is free, and you are cordially invited. Radio Corporation of America, Radio City, N. Y. 20.

RADIO CORPORATION of AMERICA

World Leader in Radio — First in Television

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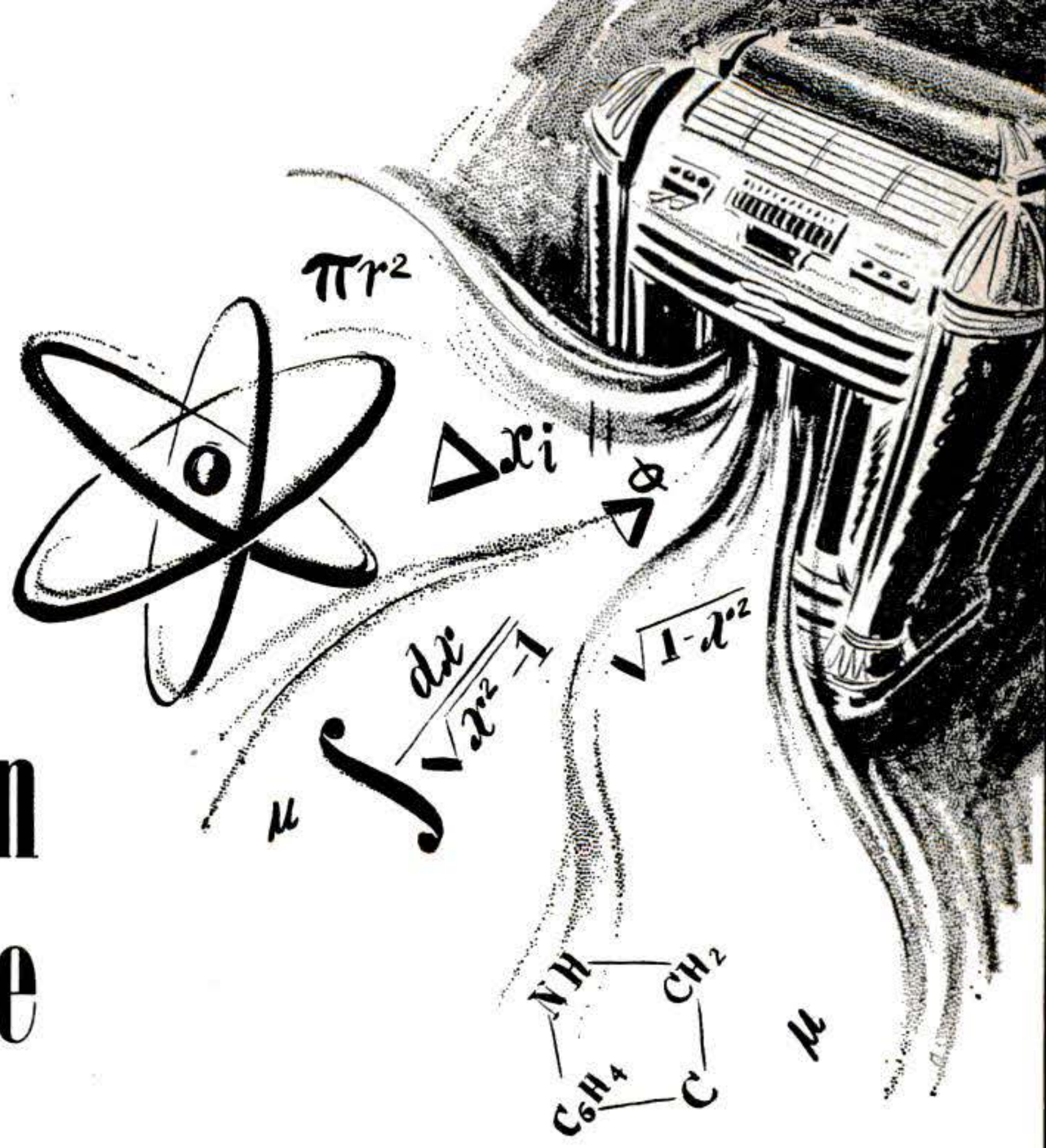
PS
The Voice of Science



How to Listen to Science

ALL you need to play a juke box is a nickel.

You don't need to know music. You don't have to finger an instrument, or write music, or even read it, to listen or dance.

And certainly nobody expects you to pass an examination in the complex process between the first clunk and the last note. It would be hard for anybody to explain the whole business of converting an unheard humming in the composer's head into the coded dots of written music; the sound waves of voice and orchestra; the grooves in plastic, needled back into sound waves, which tickle the tiny bones of the ear—and put the humming into *your* head.

Science is something like music: you don't have to know it to get it. Like music, science has its own language. And it is as impossible to put "nuclear fission" into everyday words as it is to spell out the hit songs of "South Pacific" to a naked native of the real South Pacific.

But playing the tunes will put the beat in his feet.

Ever since Hiroshima, POPULAR SCIENCE has been beating the drum for the Big Science Show. Not to simplify science—for that cannot be done, any more than a whole orchestra can be expressed with a couple of sticks on a taut skin. Not to enlist the fullest comprehension of the few—for that is not the function of the most widely read science magazine in the world. Rather to arouse as many people as possible to awareness of the new importance of science.

We think you ought to know that Public Science has become the biggest nickel-snatcher in the country. That you ought to listen, whether you can tell one atomic note from another, to the new recordings of the big experimental bands now playing the strange new tunes we must all dance to.

These hit tunes of the Big Science Show are hard to take. They have unfamiliar words and melodies. Words like "neutron" and "proton" and "meson." But you can remember when the words "nuclear fission" were strangers to the news. The important thing today is not how many comprehend the process, but how many accept the effect.

If you really want to know the electronics and physiology between your nickel and your ear, that's good. But don't think you must read or write science to catch the beat of its new tunes. Or grasp the meaning to accept the significance.

Don't worry about the words in this or any other issue of POPULAR SCIENCE. Some of them are new to scientists, too. Just lend an ear, because Public Science is playing on your nickel, your life—and ours.

And you own the juke box.

Perry Gittings

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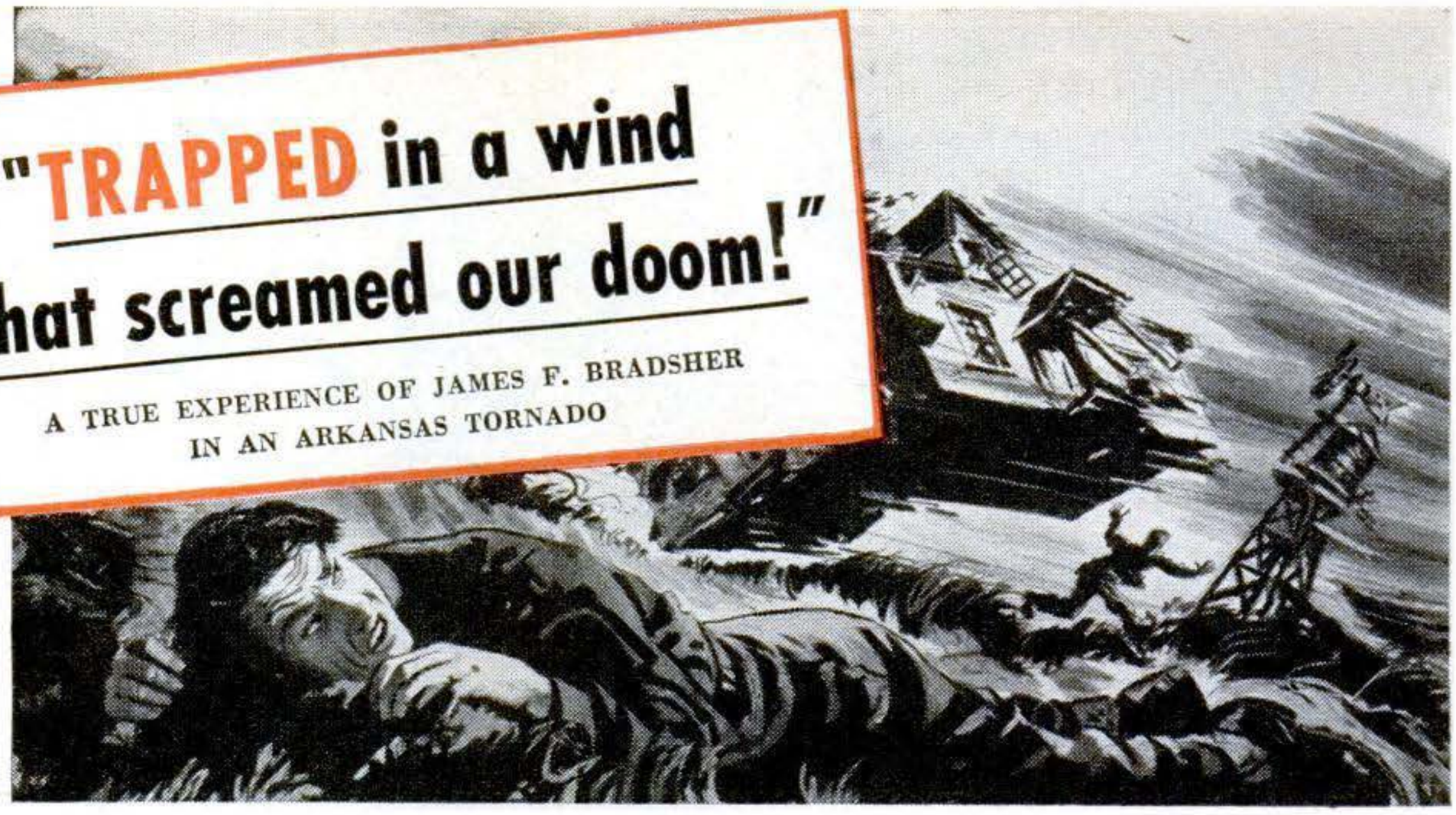
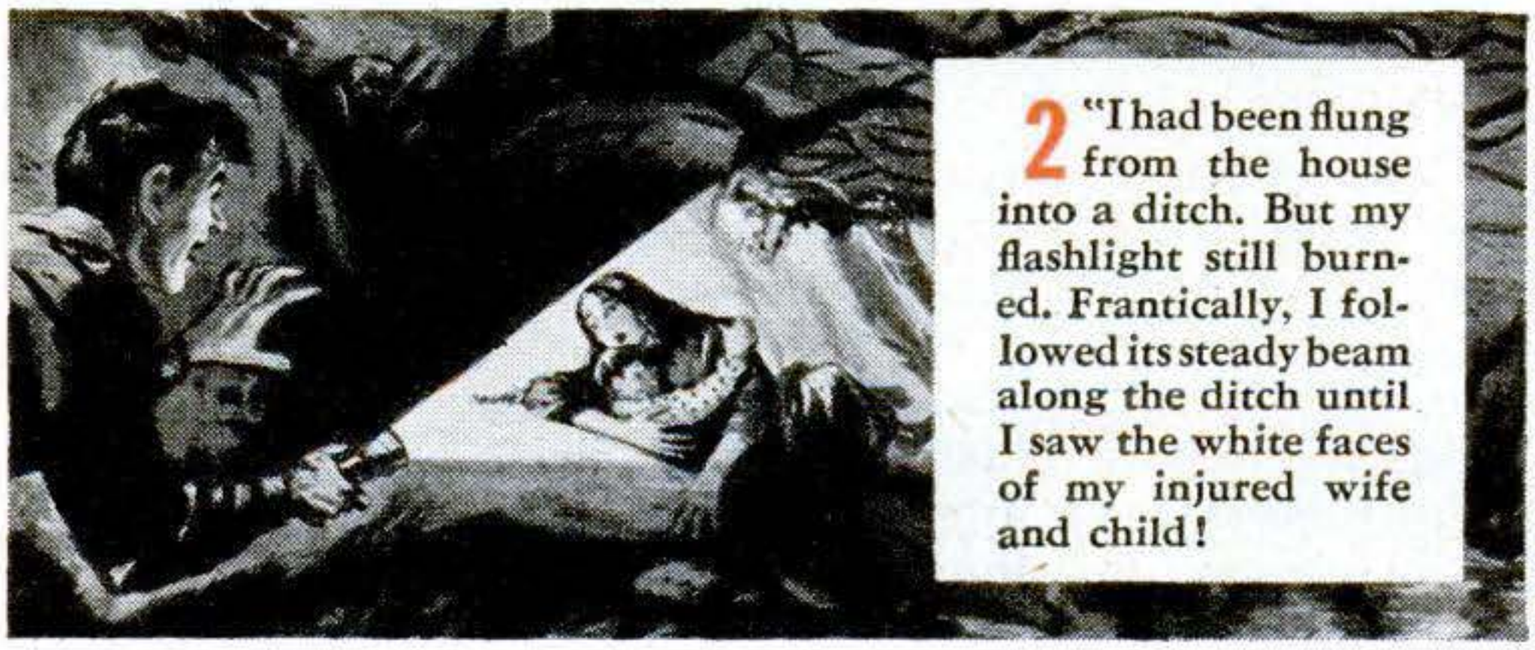
"TRAPPED in a wind that screamed our doom!"

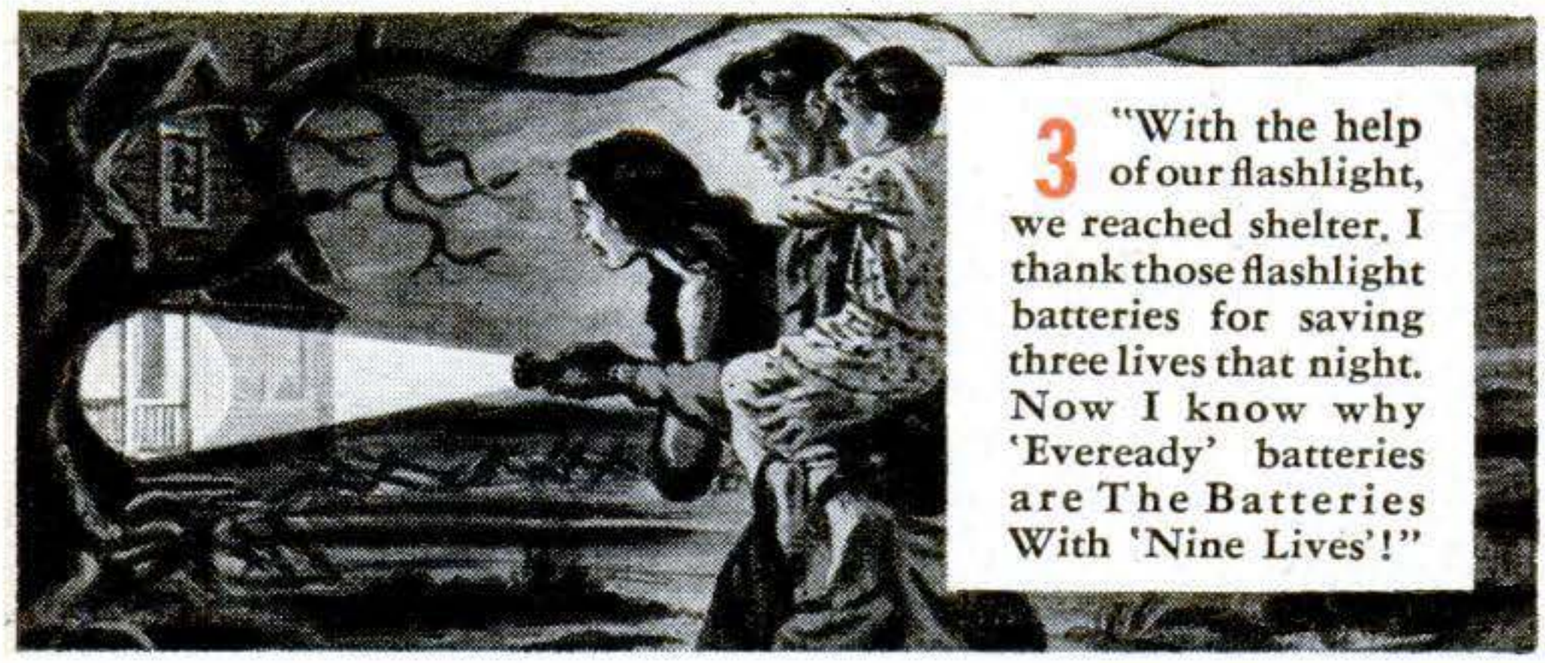
A TRUE EXPERIENCE OF JAMES F. BRADSHER IN AN ARKANSAS TORNADO



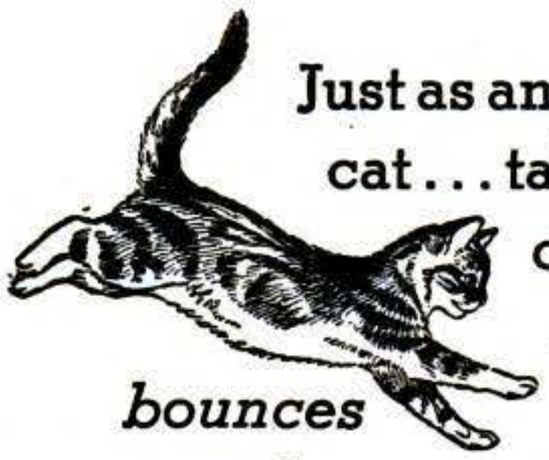
1 "Near midnight, we heard it! A sighing whisper . . . a whining gust of wind . . . a shrieking blast! The full fury of the tornado struck! My wife screamed! My child whimpered. I grabbed my flashlight. Suddenly . . . the whole house churned . . . spun in air.



2 "I had been flung from the house into a ditch. But my flashlight still burned. Frantically, I followed its steady beam along the ditch until I saw the white faces of my injured wife and child!



3 "With the help of our flashlight, we reached shelter. I thank those flashlight batteries for saving three lives that night. Now I know why 'Eveready' batteries are The Batteries With 'Nine Lives'!"



Just as an active cat . . . takes a cat nap . . . and *bounces back* with new pep . . . so "Eveready" flashlight batteries recover power * between uses and *bounce back* for *extra life!*

***Technical explanation:** due to the electrochemical regeneration of the depolarizer.

THE FLASHLIGHT BATTERY WITH "NINE LIVES"!

"Eveready," "Nine Lives" and the Cat Symbol are trade-marks of

NATIONAL CARBON COMPANY, INC.

30 East 42nd Street, New York 17, N. Y.

Unit of Union Carbide and Carbon Corporation

Write us about your true experiences with "Eveready" batteries. Address Dept. P.S.

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Paving a Big Gutter . . . This big paving project would make a fine speedway—if it didn't have a more important job. The giant ditch is the main canal of the Columbia Basin Project, soon to irrigate 1,250,000 acres of potentially fertile desert in Washington State. The life-giving water will be pumped from Lake Roosevelt behind Coulee Dam to a storage reservoir (PS, Aug. '49, p. 156) and then will flow through this canal to the farm area. Paving the canal requires these four machines: at top is the trimmer, which prepares the foundation; next the lining machine, to place the concrete; then a "jumbo" that makes expansion grooves and also carries workmen doing hand-finishing; and last in line, a form with equipment to spray curing compound on the fresh concrete.

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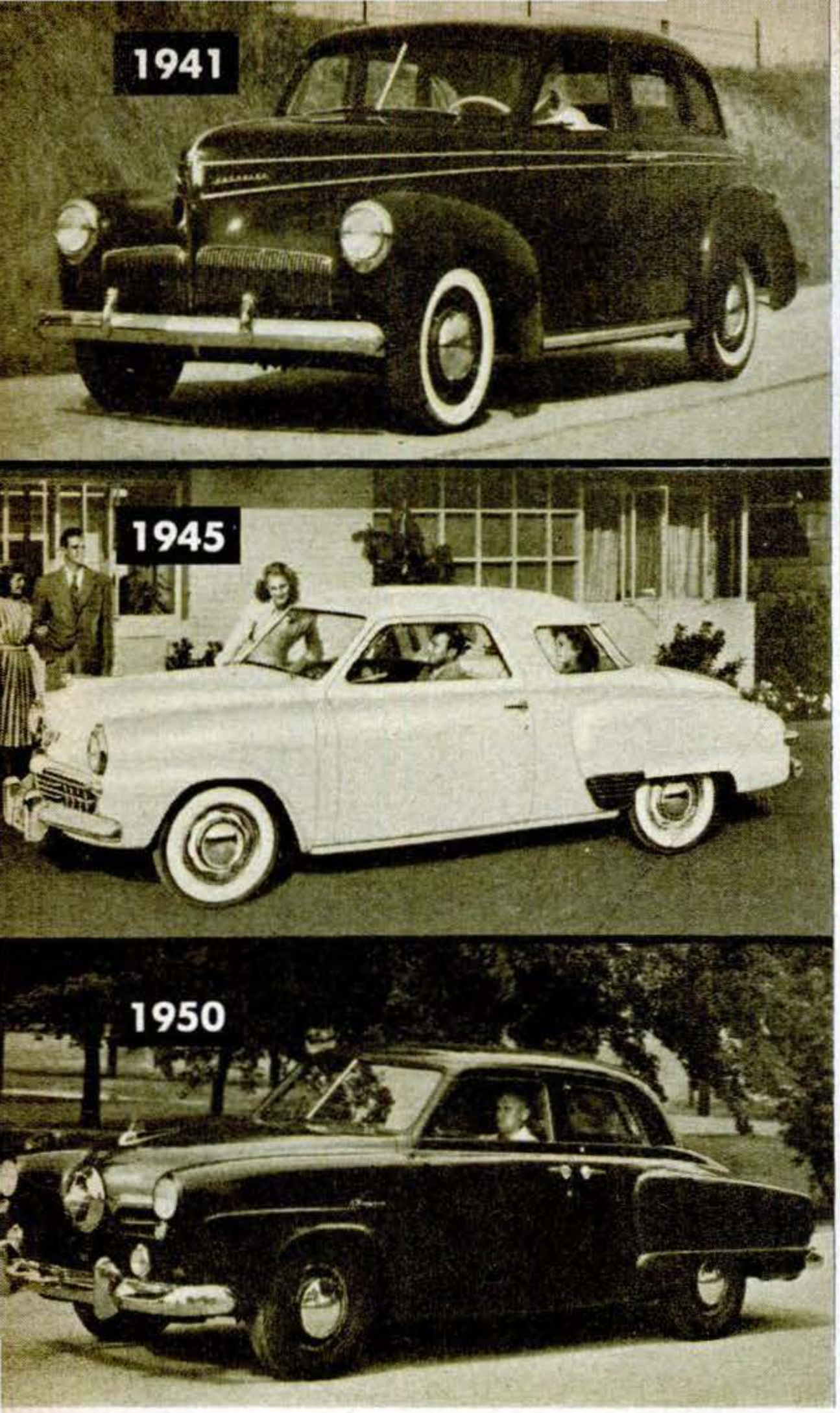

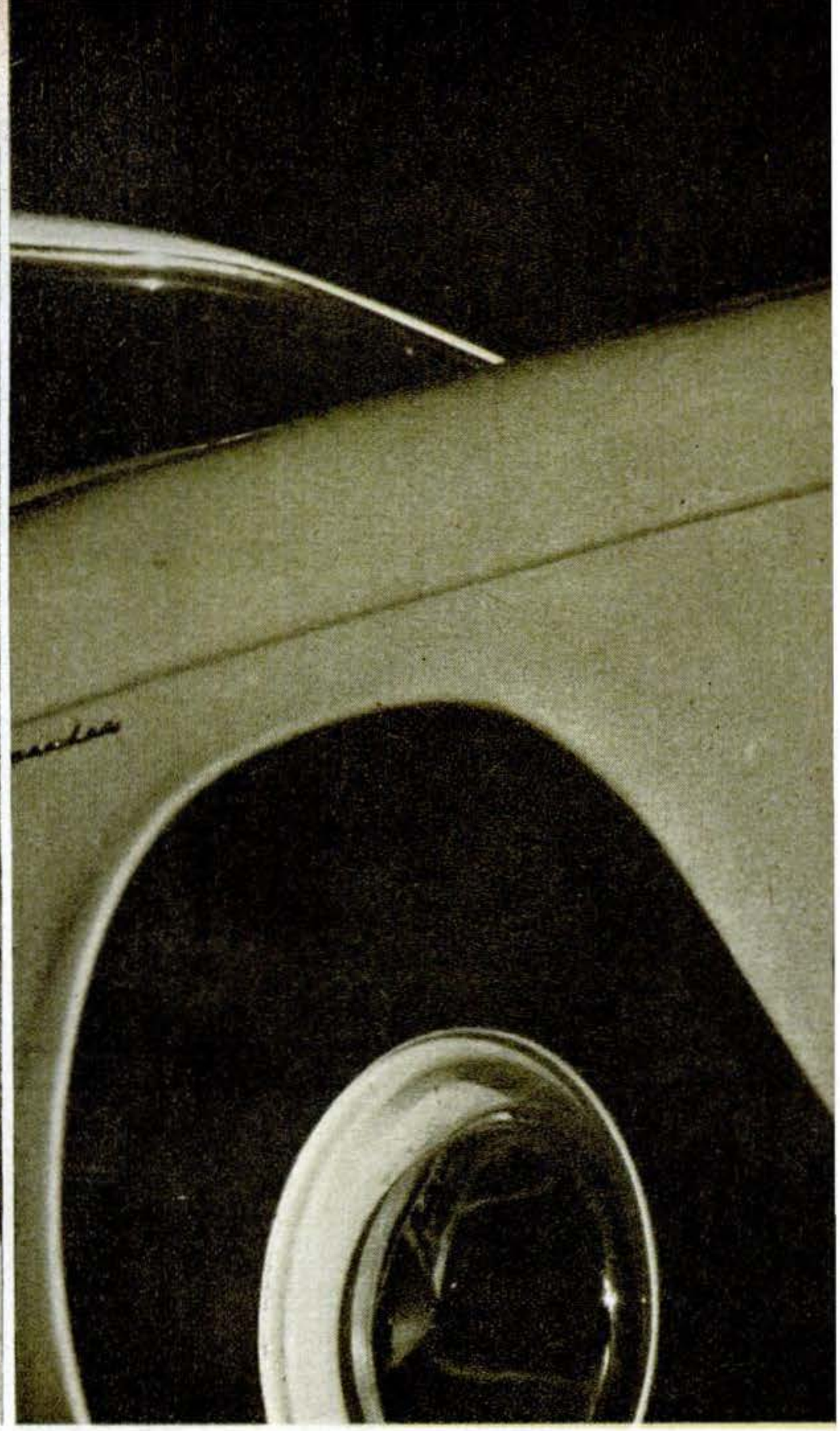

Studebaker Champions® of three vintages show the striking changes made in last nine years.

Studebaker's New Aero Nose

Designers abandon boxy front for sharp streamlining; engineers add tuned springs to smooth rough roads.

By Devon Francis

WHEN the late war was in its last months, the Studebaker Corp., pioneer automobile builder, called its designers into conference. The company's top hands wanted a new car that would be radical enough to make the public whistle—and buy.

The designers produced it. And everybody knows what happened. The cars with the wrap-around glass and the front and back ends that looked alike got as thick as fleas on the highway.

Late last month Studebaker did it again. The public whistled—again—with good reason. For the 1950 Studebakers put on display were as radical a departure from conventional design as were the cars the company produced just after the war.

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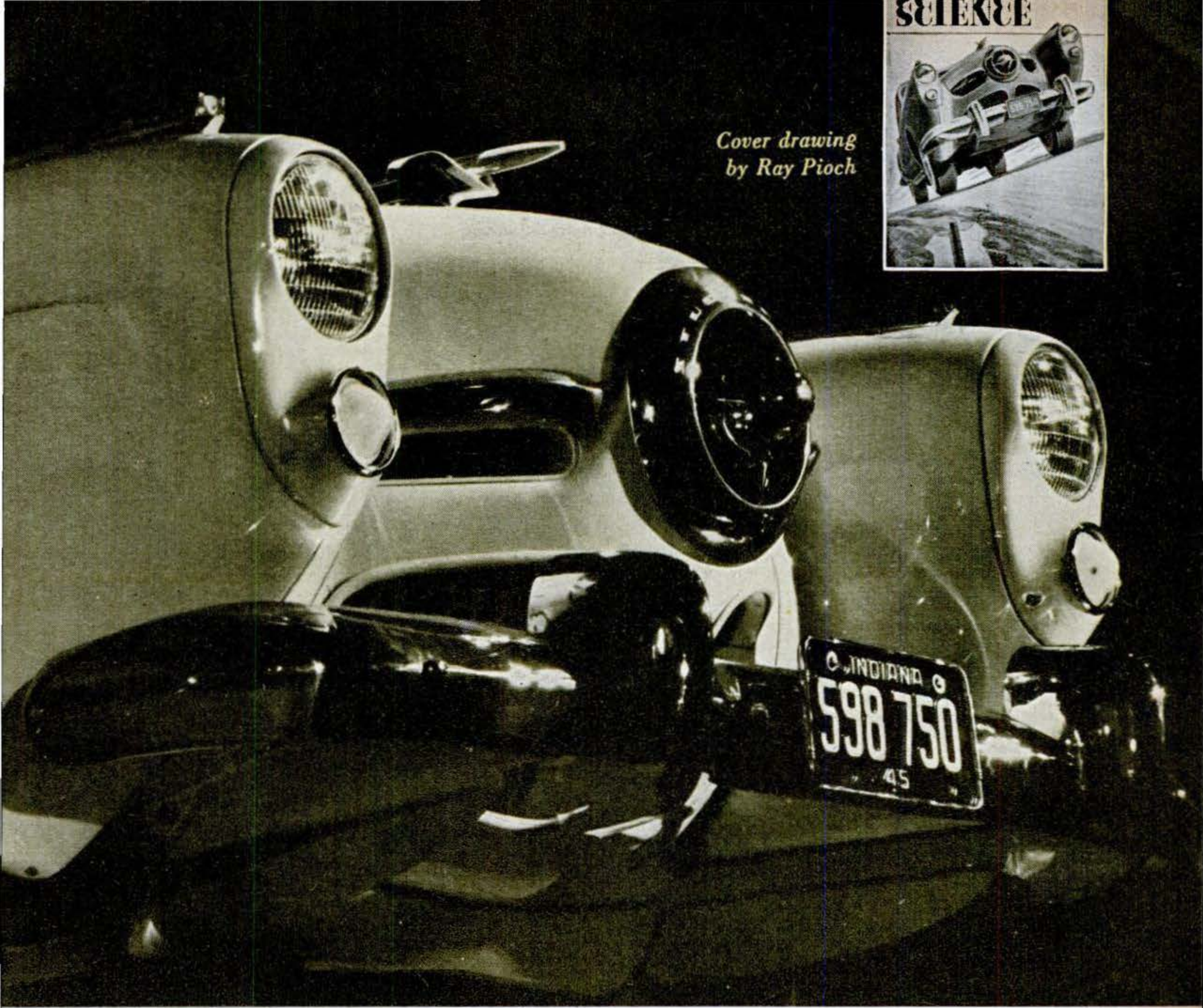

Cover drawing by Ray Pioch

Stylists seeking departure from boxlike appearance of today's cars adopted airplane motif.

Reverses Styling Trend

Their front ends look like the noses of transport airplanes—which is exactly what the stylists intended. Beyond the way they look is something else—a riding quality that should make their owners the most boastful bores in town.

Here's the way Raymond Loewy Associates, the industrial designers who have been styling Studebakers for years, explain the appearance of the 1950 series:

"We aimed for the light, fast impression of an airplane. We felt that it was time to get away from the 'forehead hood' that had been used in practically all automobiles for years. We wanted to break up the boxlike appearance that has been common to all postwar cars.

"If we could give our cars a feeling of motion and speed, we'd have succeeded in going directly against the current trend. What better way was there to do it than to peel the car away from the front of the hood? The car now *cuts* its way through the air, like an airplane."

There was a consideration, a lesser one, apart from appearance, too. An automobile burns gasoline mainly to overcome friction. That comes down mostly to the

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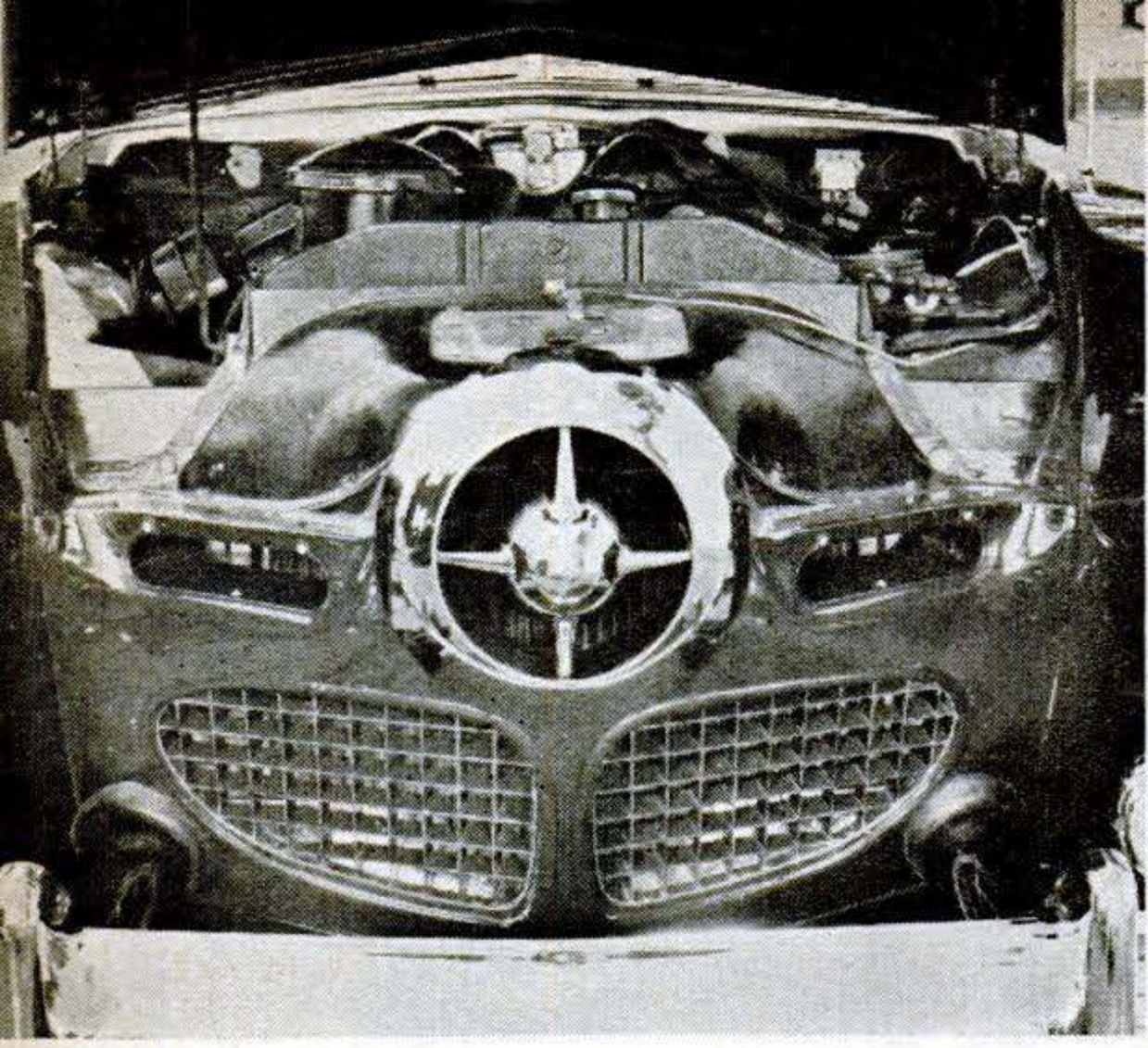

Compactness dictated by the styling so altered the flow of cooling air that baffles had to be inserted behind inlets in grille. One baffle, to capture air at top, is seen above emblem.

Workman shows how far the wheel travels while compressing spring after bump. Commander, Land Cruiser—companions to Champion above—have 120-, 124-in. wheelbases.

friction of the machinery and friction with the road. But friction with the air cannot be forgotten, either. A head wind is quite an item with the big highway freighters (PS, Mar. '49, p. 128). Studebaker feels that a car with a boxlike front end has to displace an awful lot of air at today's smart clips on the open road.

Aero Noses Waited Two Years

And finally there was the consideration of sales. Studebaker, still selling cars that it hasn't produced in what generally has shaken down to a buyers' market, wanted a shot in the arm for the guy meandering around a salesroom floor with an itch to buy. As a matter of fact, the styling for 1950 has been on ice for two years. There were men in the company who were arguing for the airplane-nose car back in 1947. They lost. Older heads said it wasn't time yet for that design.

Candidly, not much else has been done to the 1950 series back of the front end—until you come to the suspension. Front fenders are jaunty and have been extended several inches beyond the point reached in current Studebakers. That's another result of the stylists' attack on boxlike fronts. Minor modifications have been made to the rear fenders.

Bodies are practically unchanged. The wrap-around glass, perhaps the chief aesthetic appeal of the first postwar Studebakers, remains the same. Engines—with their high economy—and transmissions are right-off yesterday's production lines. Concessions to the sales department have been made in the appearance of the instrument panel. The changes are efficacious. For one thing, recessing the dials prevents any possibility of their picking up glare.

The other important item in the new cars is the springing. For the first time, coil springs have replaced the transverse spring in front. But that's only incidental. What Studebaker has done is make a meticulous study of the whole subject of bumps and vibrations—and how to keep them from becoming uncomfortable.

As the representative of POPULAR SCIENCE at Studebaker's proving ground west of South Bend, Ind., months ago, when the 1950 cars were on their shake-'em-apart tests, I passed off the change in the springing as another one of those things—until I drove the cars. Don't let anyone tell you that you can't pilot one of these automobiles down a washboard road at 50 to 60 in comfort. I did.

New Cars Smooth at Top Speed

First I took the Champion®, Commander®, and Land Cruiser®, the company's three models, out on the oblong and dished speed track, rated at 80 m. p. h. It took me several tries before I could make myself keep the accelerator down on the turns. It was Francis versus Faith, and Faith kept losing. But eventually I found that even at top speeds the cars rode like Pullmans.

Then I drove the cars—and three com-

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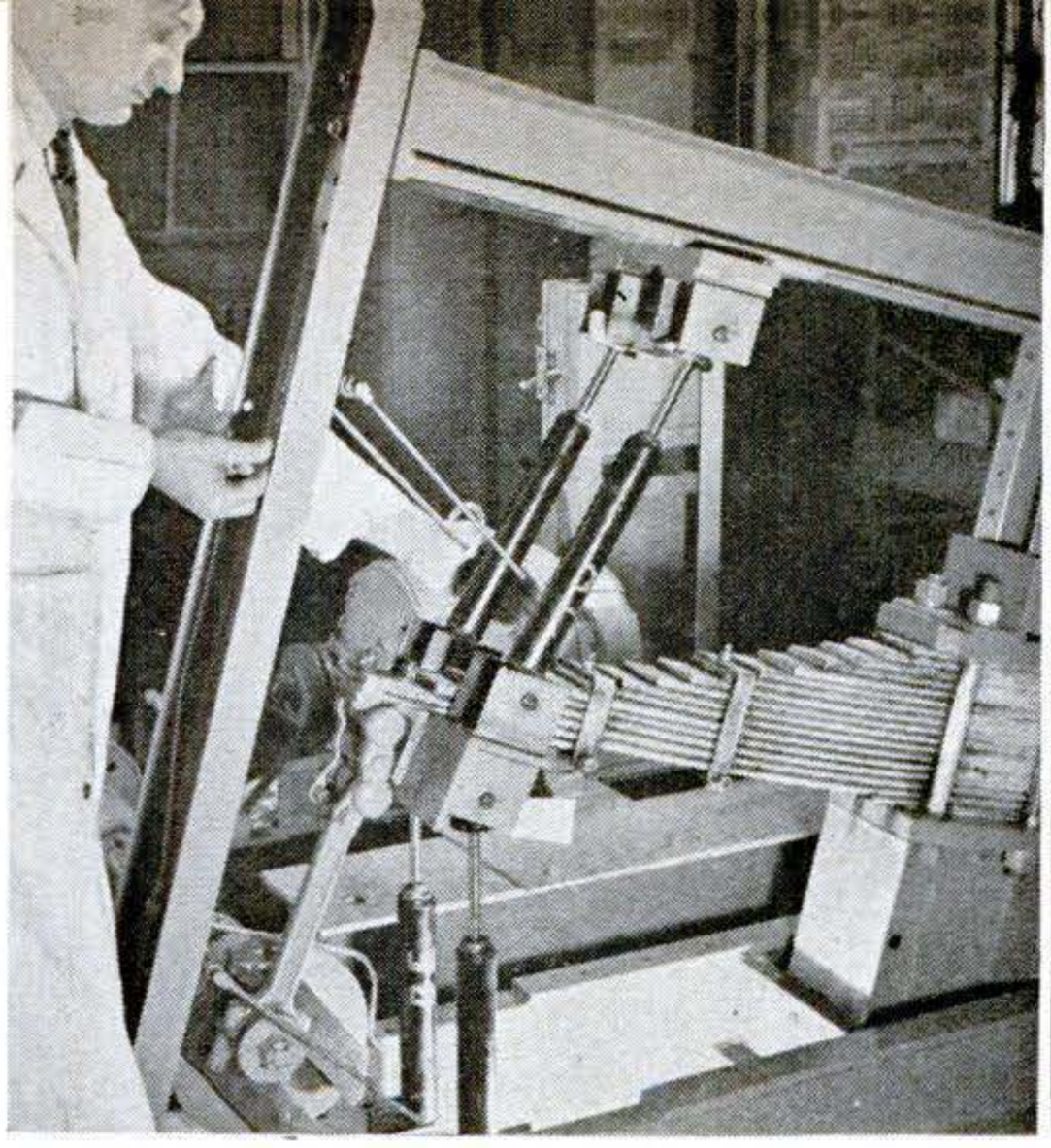
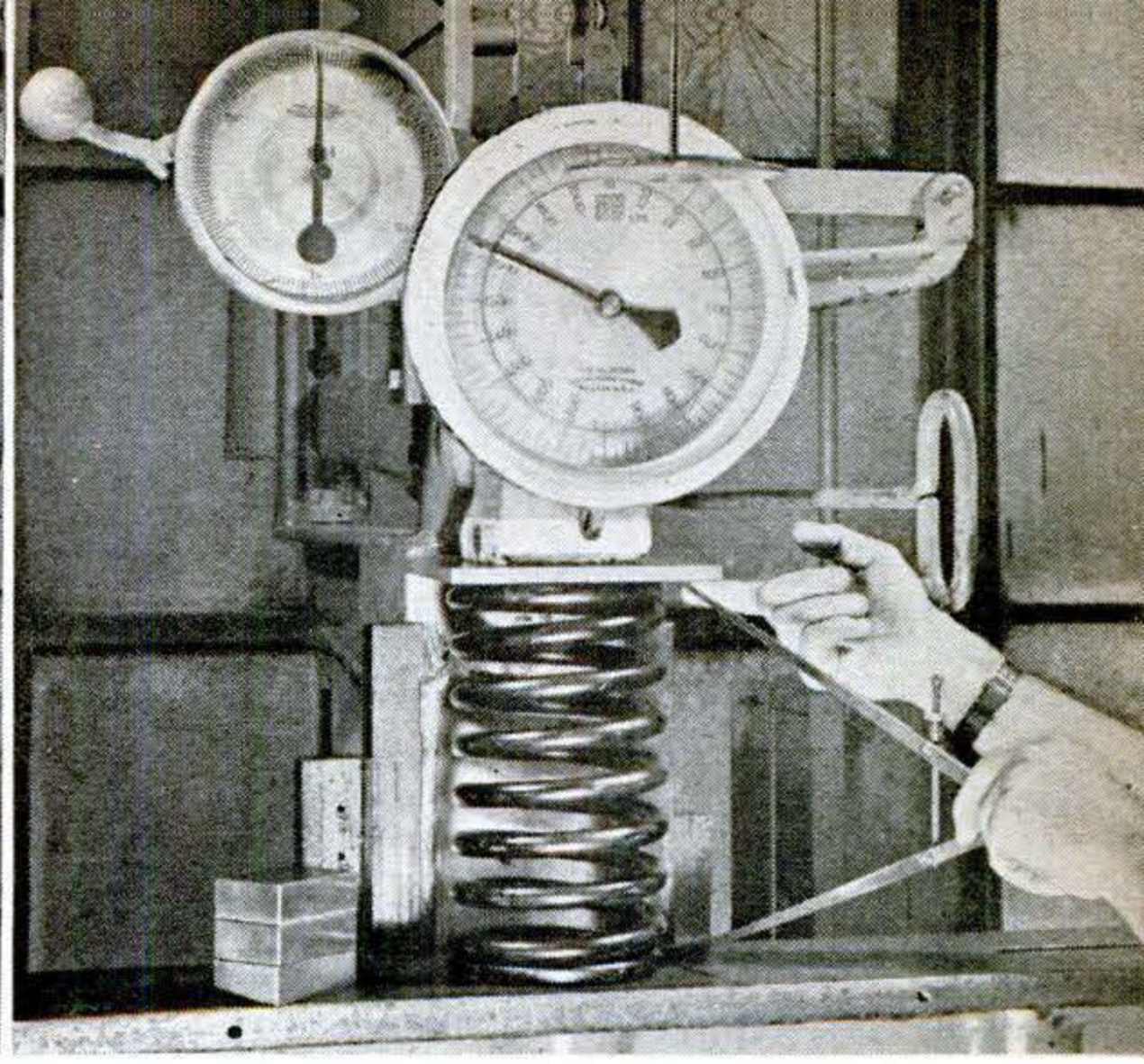
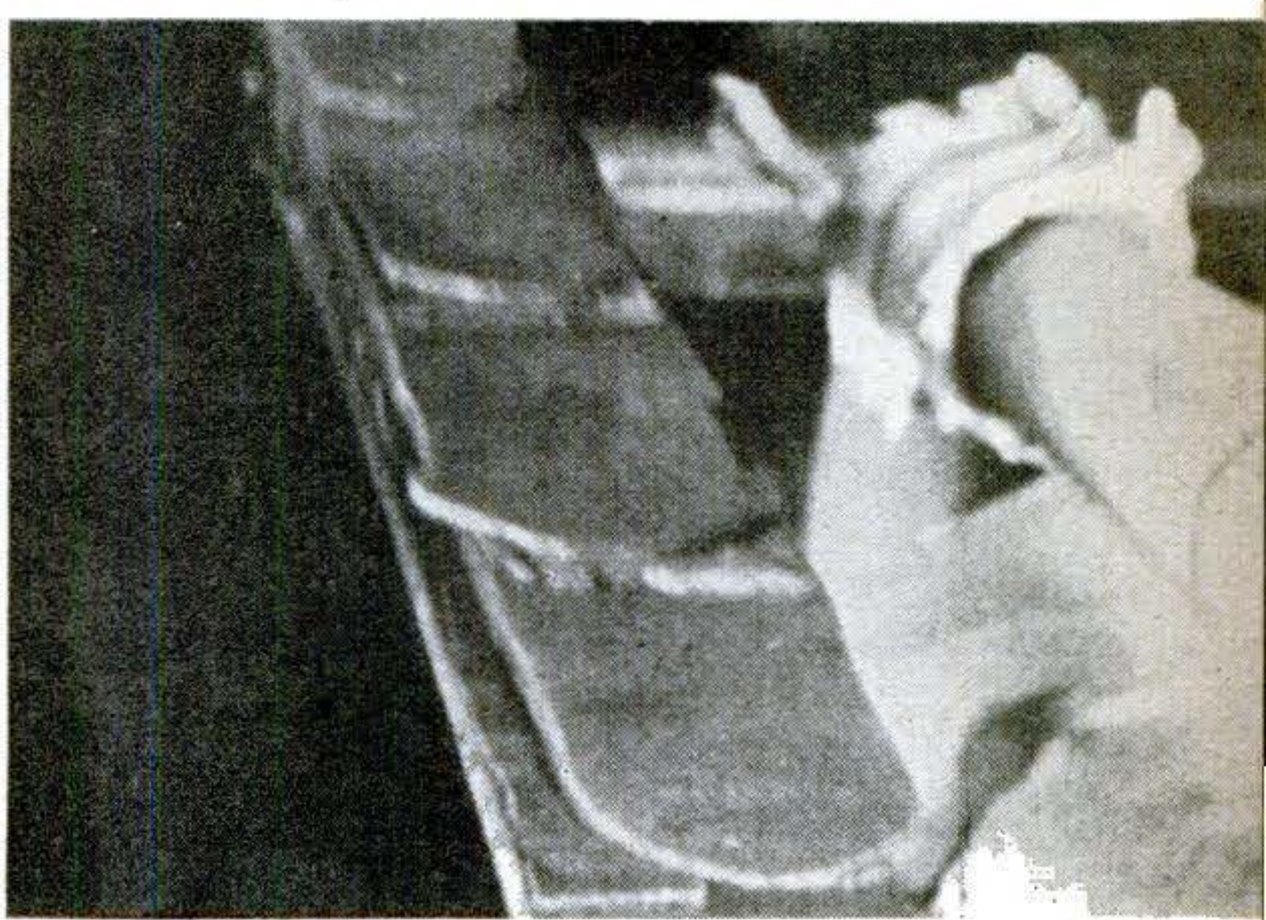


Technician directs stream of cooling air on shock absorbers, which are getting a 3,000-lb. load 16 times a minute from 17-plate spring. Calibrating springs eases ride on rough roads.



In choosing front coil springs to replace former transverse type, they were tested for carrying height and "rate." Here engineer measures spring for characteristics under 1,625-lb. load.

New Studebaker takes a bump at 40 m.p.h. on proving ground's "Route 1." Single mile of it is considered equal to 8 to 10 miles on normal rough road. Each test car got 600 miles of this.



Violent side-to-side gyrations of leaf spring as one of rear wheels hits a bump are shown in this photo. Objective was to find ways to minimize spring wear and side motion of car body.

petitive cars—on the hill-and-dale, gravel, bumpy, and washboard roads at the proving ground. These Studebakers were all handmade machines. The production jobs will even improve the performance.

I hit bumps at 35 and 40 that almost shook out my eyeteeth in anything but the 1950 Studebakers. I included alternately spaced bumps to whack each wheel separately. The new cars had a remarkable glide and shock-recovery. I won't say the washboards didn't set up vibration. They did. But it was not unpleasant.

Curious, I went to see the engineer in charge of springing and shock-absorber calibration at the factory.

First off, he asked, "Who's going to ride in these automobiles? People. So why not use the human body as a laboratory in finding out what we need in the way of vibration frequency?"

He said: *"You can't eliminate vibration, but you can attune it to the vibration frequency the human body is accustomed to."*

Springs have two performance attributes: rate and frequency. Rate is the amount of load it takes to deflect a spring one inch. Frequency is the number of times a spring will go up and down each minute if it is disturbed. The proper rate is necessary to carry the load. The proper frequency, like that in a violin string, is necessary to

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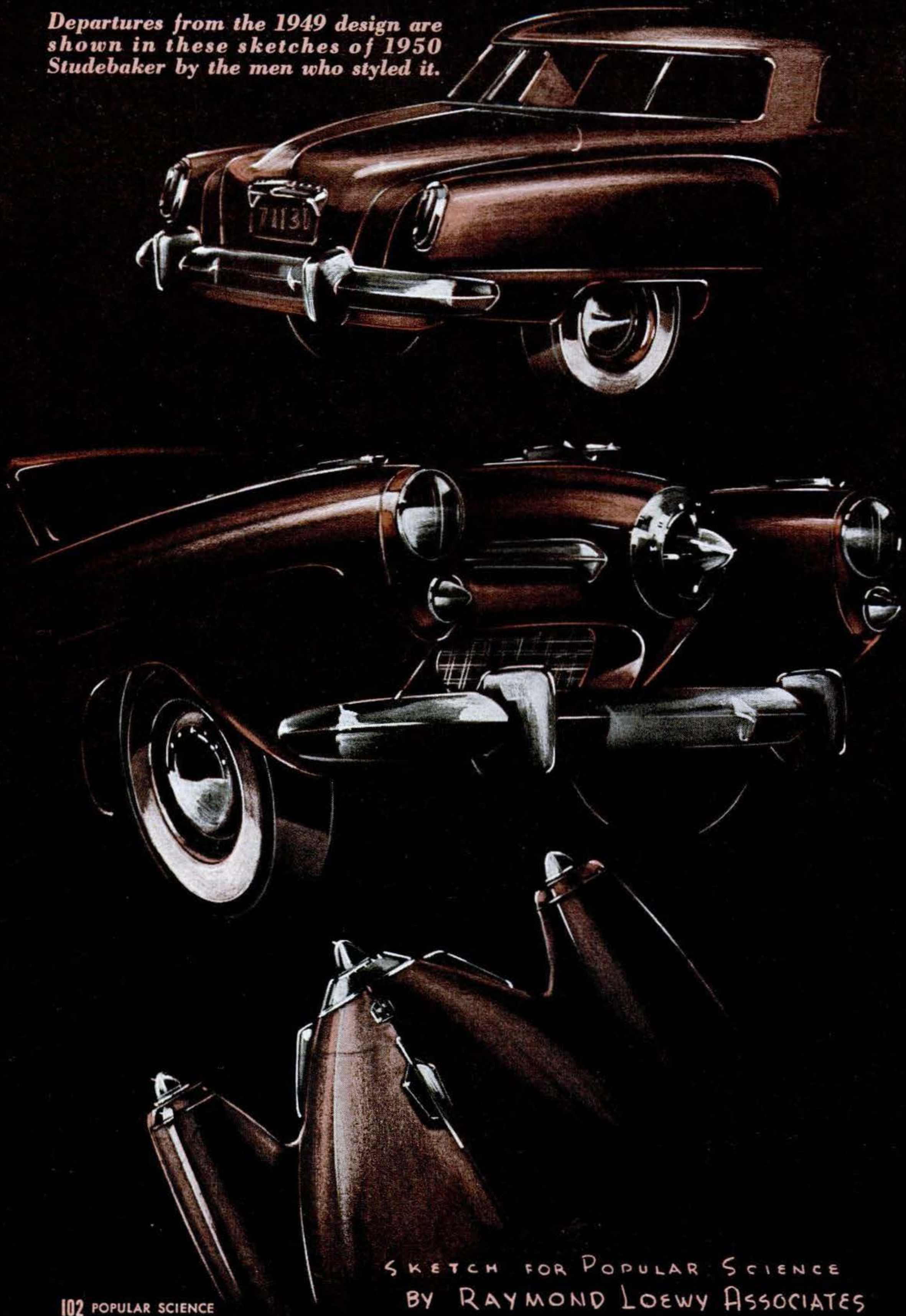
Departures from the 1949 design are shown in these sketches of 1950 Studebaker by the men who styled it.



SKETCH FOR POPULAR SCIENCE
BY RAYMOND LOEWY ASSOCIATES

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produce a given result—in this case, to keep driver and passengers happy.

Keeping them happy goes back to the frequency the adult body likes. The body can take between 70 and 100 shocks a minute with composure. That's based on the shocks encountered in walking—your heels hit the ground 70 to 100 times a minute when you walk two or three miles an hour with a 30-inch stride. You scarcely notice the jar because you are used to it.

Softening Springs Increases Rate

So, when the new Studebakers are fully loaded, their springs have a cycle (or frequency) of 80 in front, where the weight is greater, and 70 in the rear. To get low frequencies, the springs had to be made so that they would deflect easier and farther. That posed the problem of wheel travel. So when the wheels hit a bump and go up, on the compression stroke, the travel is a full four inches. On the rebound it's a full five inches. Studebaker had to do some finagling with wheel housings to give the wheels room to move in.

One other item entered into the suspension. A "rake angle" of 5 degrees was engineered into the wheel mounting; when a wheel hits a bump, it rebounds backward *away* from the bump. This was accomplished in the new design merely by canting the support arm.

The shock absorbers were corrected to 100 cycles a minute. That was a compromise. Actually, on a washboard road at 40 miles an hour, you are likely to get as many as 600 vibrations a minute.

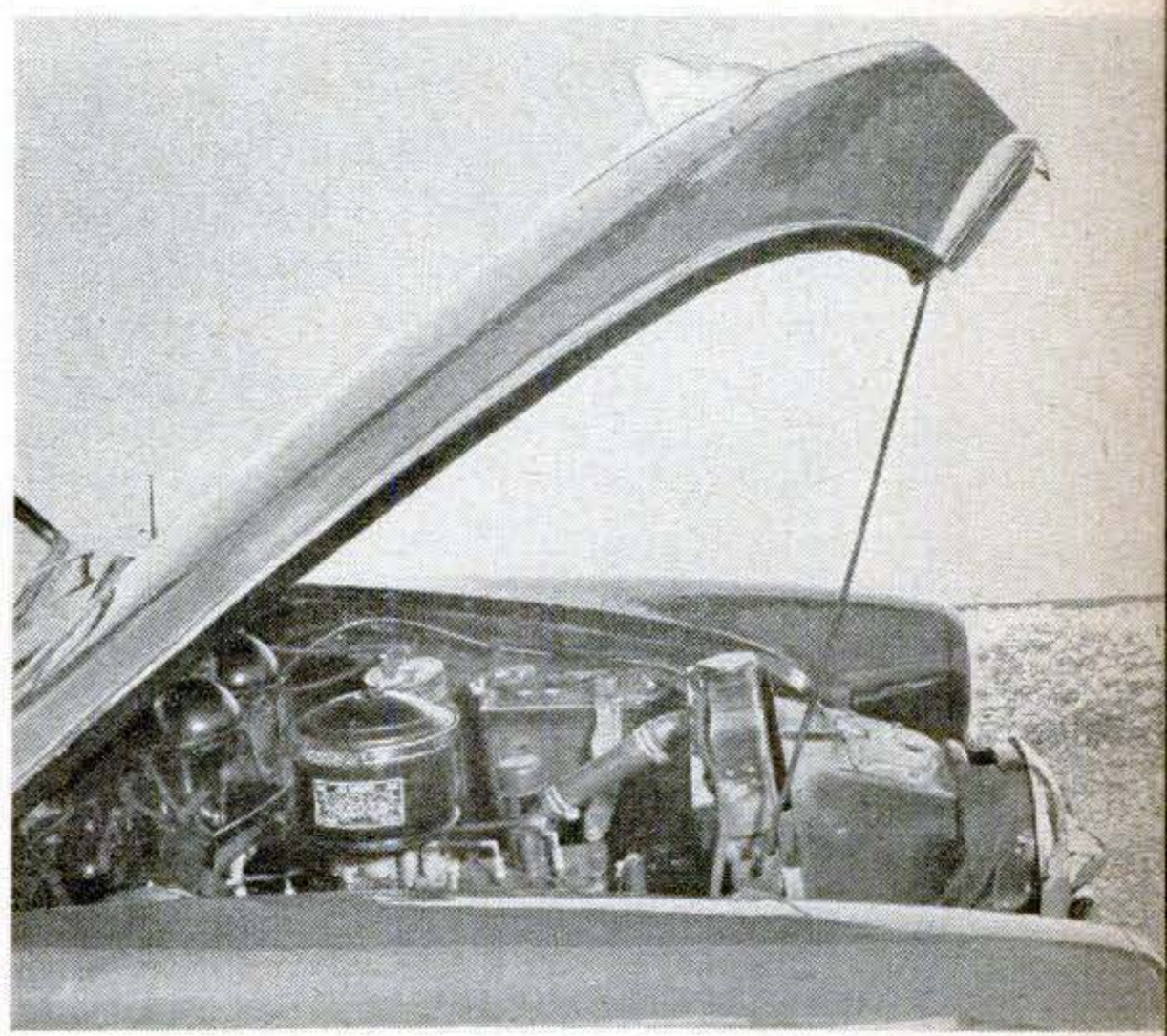
Transverse Movement Also Limited

Studebaker's study of the riding qualities of its new models was intended to limit all four of the motions resulting from the impact of road irregularities on the wheels—roll, pitch, up-and-down movement, and transverse movement.

The transverse movement of the car comes from the wheels on one side hitting a bump. The front wheels bounce up and down in an arc, compounding the stresses. Regardless of whether it's a front or rear wheel, the movement is transmitted to the frame as a side-to-side stress. Sea-leg type of shocks in the rear help control this stress. So do rubber shackle bushings.

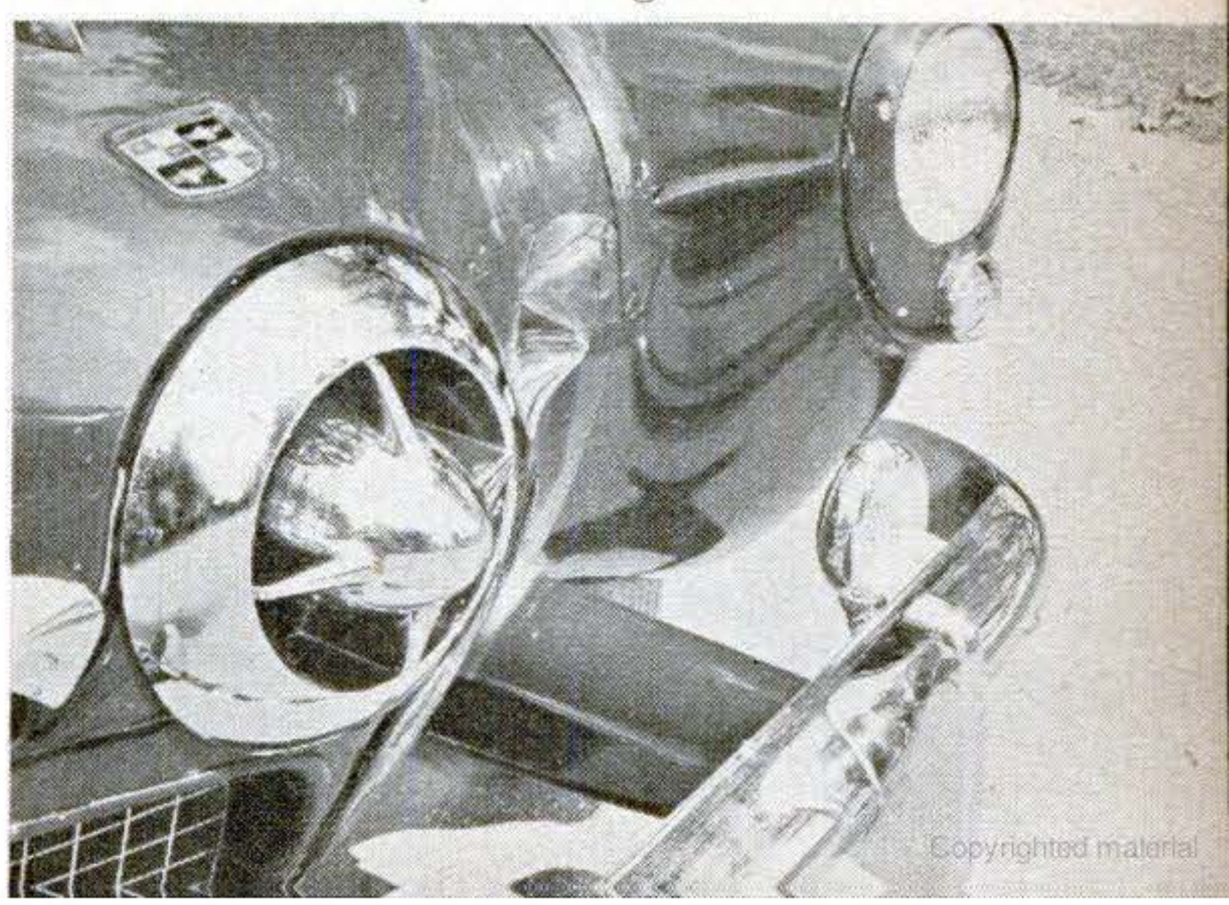
Paul G. Hoffman, the man who authored the first of the company's postwar cars, no longer is at the Studebaker helm. He's ➧

New Champion, with over-all length of 197¼ in., projects 5¼ in. beyond front of 1949 version with wheels exactly aligned. New wheelbase of 113 in. is only 1 in. longer, however.



Shrinkage of under-hood space by abandonment of fat front-end design posed housing problem. Radiator is canted backward to fit. Bolted-on fenders are easy to replace, repair.

To add sleekness and avoid any appearance of heaviness in the front end, the bumper back bars are not concealed by the grille or the pan. The new car is wider, but height remains same.



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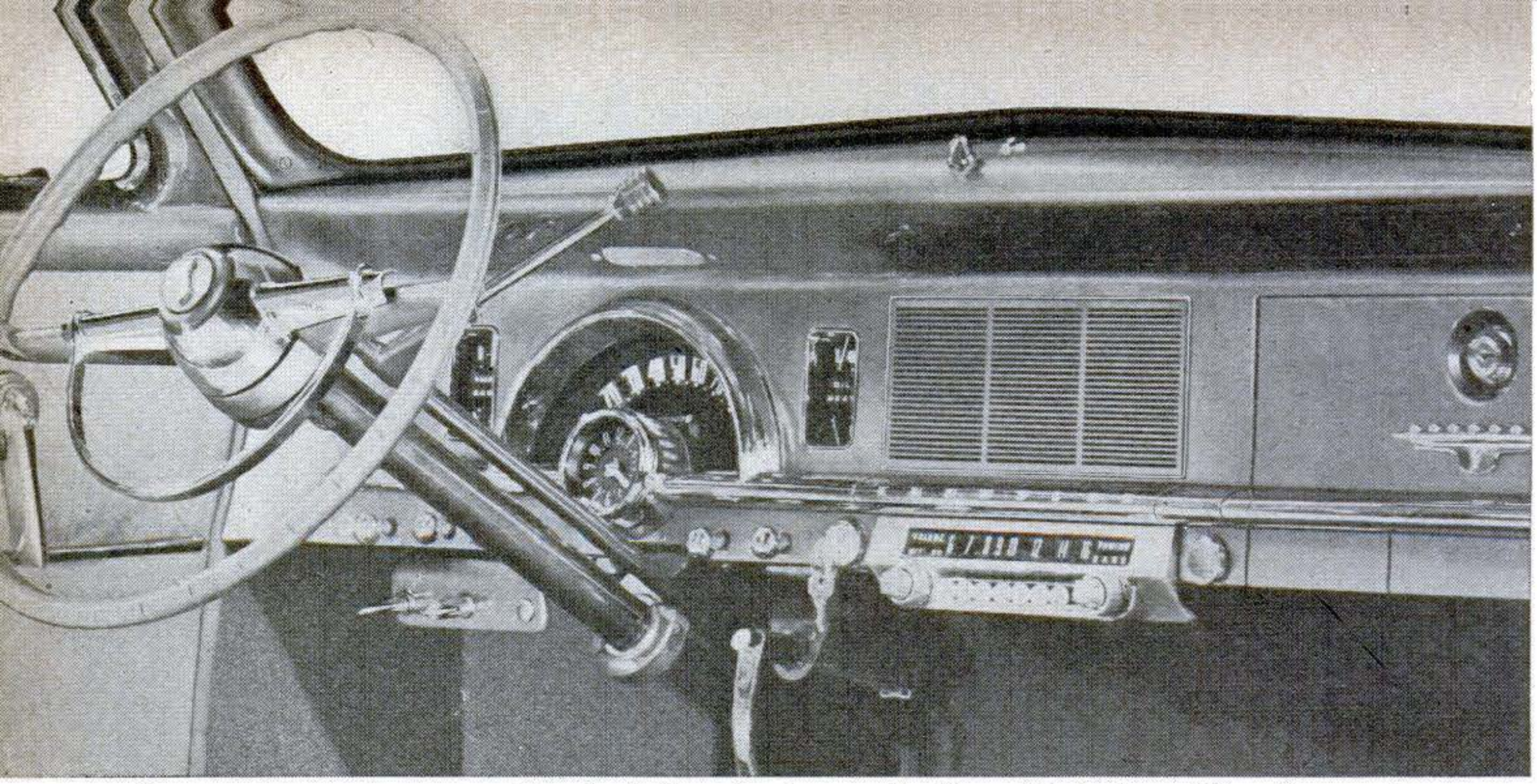


Instruments are centered in single housing in front of driver. Recessing them eliminates any reflections. Controls and handle on glove compartment also are recessed as a safety measure.

the Government ECA administrator, apportioning billions of dollars for European recovery. But his verve infuses the South Bend organization.

One day before he was called to Washington, he had one of his favorite drivers at the plant take him and a friend to Terre Haute to catch a train. It was late when they started. The driver had to roll the car at 80 much of the way. Hoffman sat in the back seat throughout the ride chatting easily, utterly relaxed. When they reached the station there were only three minutes to spare before train time.

"Have to do something about this," Hoffman remarked drily as he glanced at his watch. "We're wasting too much time on the road."

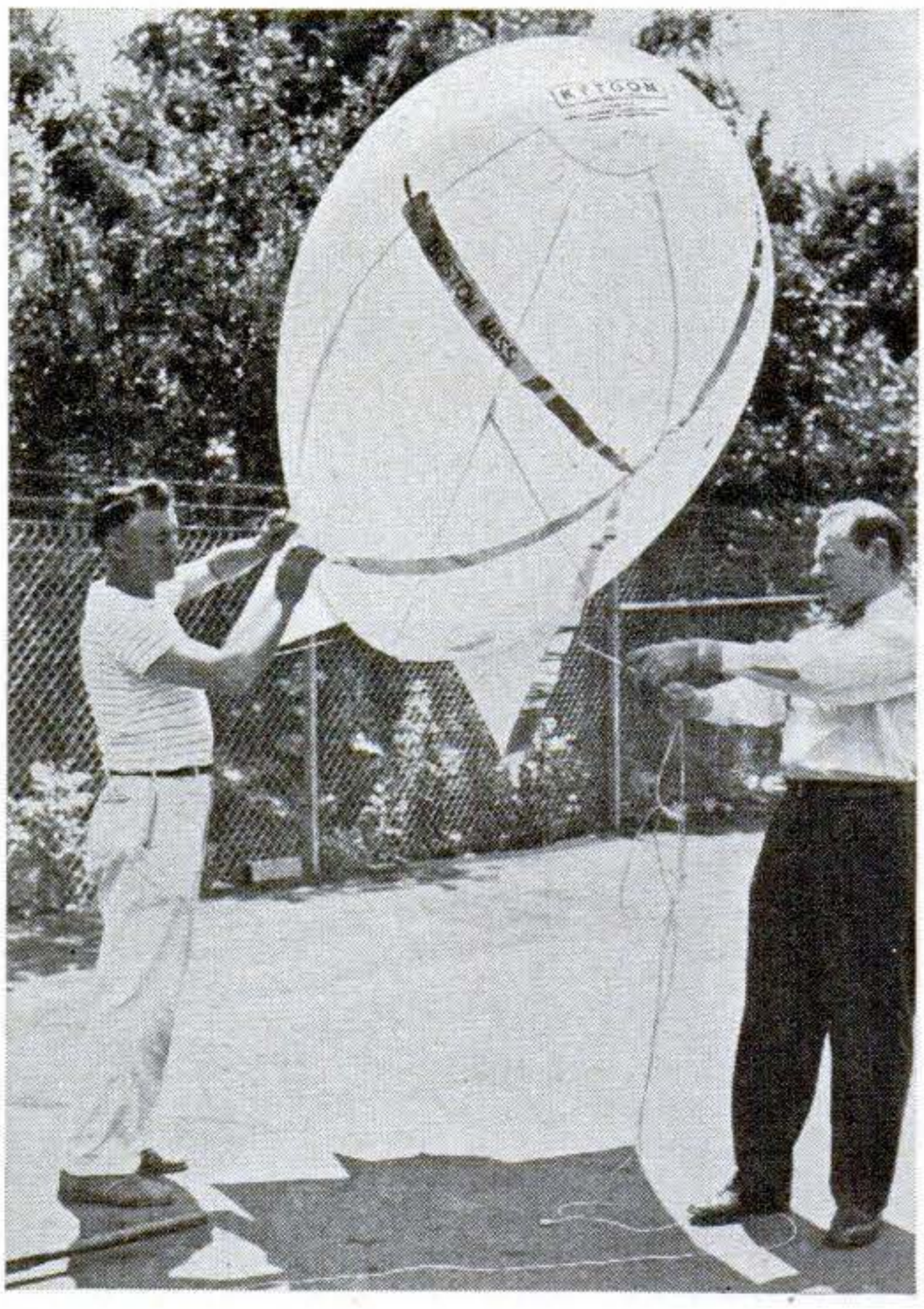
That may be one of the reasons for those new airplane-nosed Studebakers. END

Foil-Carrying Balloons Find Right Spot for TV Antennas

BALLOONS not much bigger than the ones kids play with are now helping television service men find the right place for video antennas.

The helium-filled Kytoons® actually carry a temporary antenna—strips of aluminum foil—up into the air to determine the height at which signals come in strongest. A special coaxial cable brings the signal from the aluminum-foil antenna to the ground and also controls the height of the balloon. The balloons are used in mountainous suburban areas where tall antenna mounts are needed to pick up a strong, "ghost"-free picture.

The Kytoons, which have dirigible-like fins to give extra lift and keep them steady in windy weather, can also be used to fly permanent antennas in remote locations where a roof or pole mount would give no image at all. The manufacturers, Dewey and Almy Chemical Co., of Cambridge, Mass., report that they have even shipped some to whalers—to locate newly killed whales.



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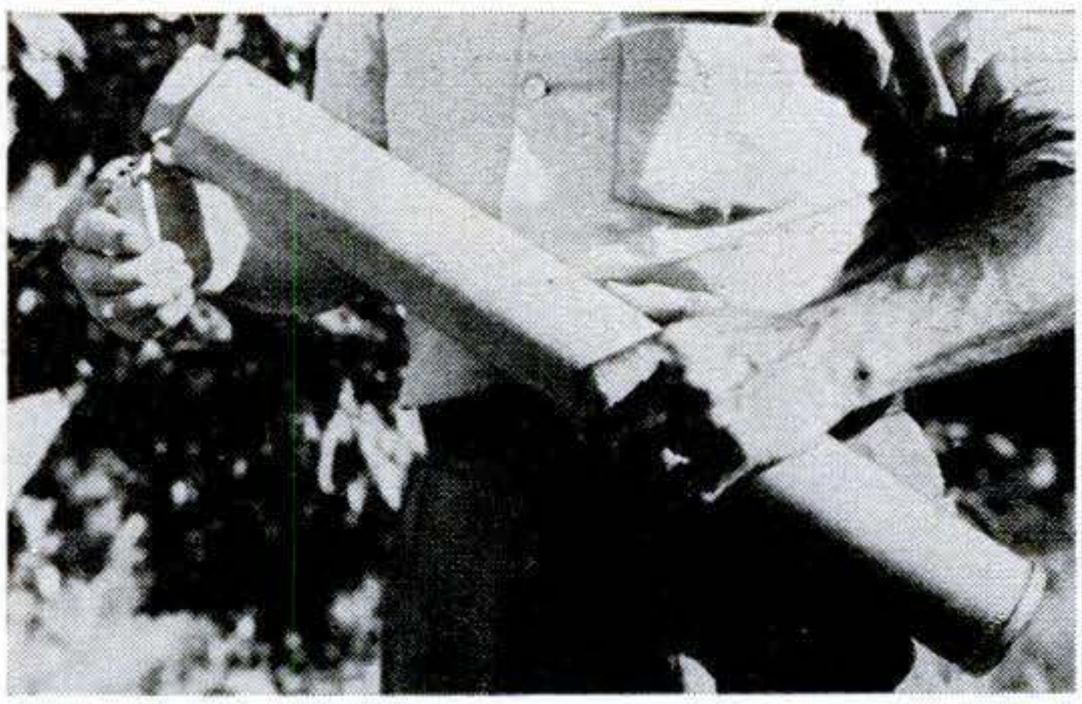
Homemade dust bomb—an ordinary cardboard container—gets a jigger charge of slow-burning gunpowder. The fuse, inserted first, can be seen projecting from the bottom of the container.

Protective wadding is placed over the gunpowder and tamped down before a few ounces of insecticide dust are added. The lid is then put on, and bomb can be loaded into the bazooka.



This bazooka—an old cardboard mailing tube with one end closed—is a muzzle-loader. Explosion of the gunpowder charge does not injure the gun, which can be used over and over again.

Ready, aim, fire! The fuse allows 12 seconds for pointing the bazooka at its target. One shot covers a small tree, or 1,000 square feet of level ground, with the insect-killing dust.

Paper Bazooka Kills Bugs

THIS bazooka fights in the never-ending war against bugs. Although made only of cardboard—an old mailing tube—it shoots down insects almost anywhere out of doors. With one shot, it can spread insecticide through the top of an apple tree or over an area of 1,000 square feet.

Robert Blair, of Washington State's Yakima Valley, designed the weapon to replace expensive spraying equipment for small-scale gardeners. The charge is a cardboard container—like those restaurants use for coffee—filled with slow-burning gunpowder and insecticide. In use, the dust bomb is slipped down the muzzle, the fuse is ignited, and the bazooka is simply pointed at the target. Various types of insect powders are used, depending on the bug to be eliminated.

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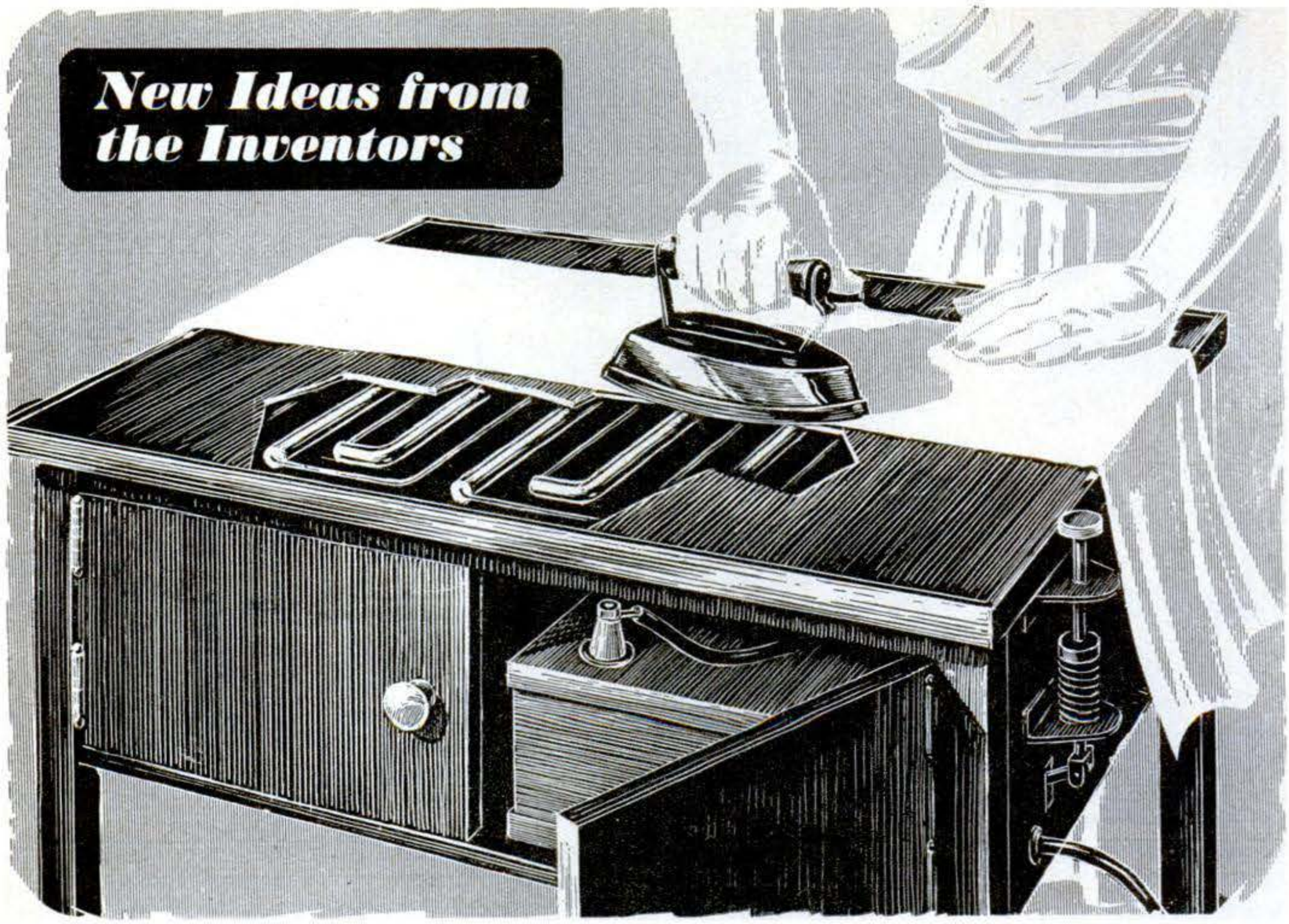
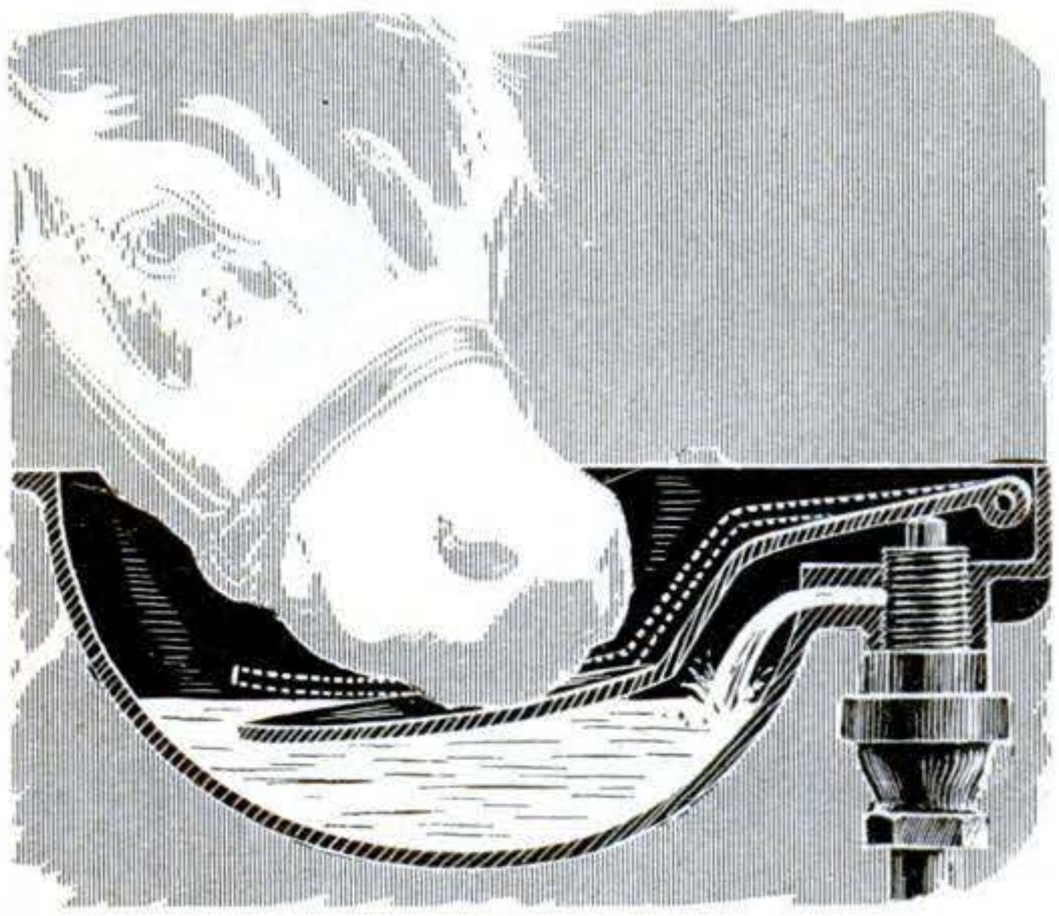
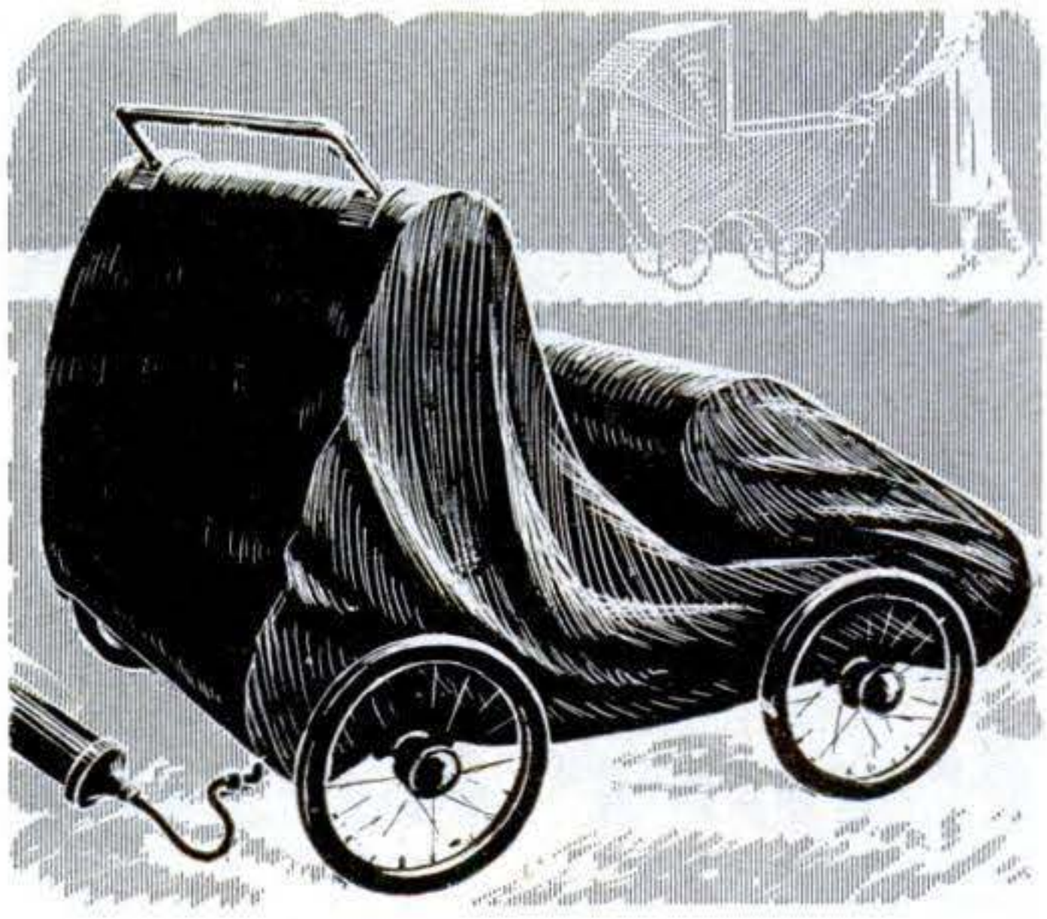
New Ideas from the Inventors



Iron Can't Scorch. You couldn't scorch your clothing with this iron even if you left it right on the material. High-frequency electrodes under the table top create an electrostatic field between them and the iron. When the cloth is damp, it absorbs energy from the field and becomes hot. As it dries, it absorbs less and less energy, losing its heat, and thus cannot burn. The inventor is E. C. Pitman, of Red Bank, N. J.



Drinking Dish Fills Itself. Thirsty cattle wouldn't have to wait for a farmer to refill this watering bowl when it ran dry. Poking their heads into the bowl pushes down a hinged arm that opens a valve, letting water from a pipe flow in. When the arm is released, the flow stops. The bowl was invented by H. E. Bremer, of Milwaukee.



Baby Rides on Air. This novel baby carriage could be blown up like a rubber life raft. Double fabric walls with air in between form the sides, ends, and bottom, while a conventional folding hood attaches to the top. Deflated, the carriage folds up for easy storage and carrying. The inventor is M. W. Newberry, of South Windsor, Conn.

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Conveyer Loads Cargo Planes. Speedier loading and unloading of cargo planes is the object of this conveyer system. Two main conveyers carry cargo between planes and the warehouse. In a circle around these are telescoping conveyers that can be extended or retracted to reach different sizes and numbers of planes. The inventors are J. Gonzalez, of Torreon, Mexico, and Y. Meer, of Wyckoff, N. J.

Shields Stop Open-Car Drafts. Like the old back-seat windshield, these clear-plastic shields for convertibles are designed to keep wind off passengers in the rear and back-of-the-neck drafts off the driver. Invented by W. Menrath, of Milwaukee, Wis., they are hinged at the top of the front seat, fold down when not in use.

Compact Lights Up. Women could get their makeup on better in dark or poorly lighted places with the compact patented by J. S. Wachtel, of New York City. It has a small bulb at the bottom of the mirror that lights up the user's face. Electricity is supplied by two pencil-type flashlight batteries, one at each side of the case.

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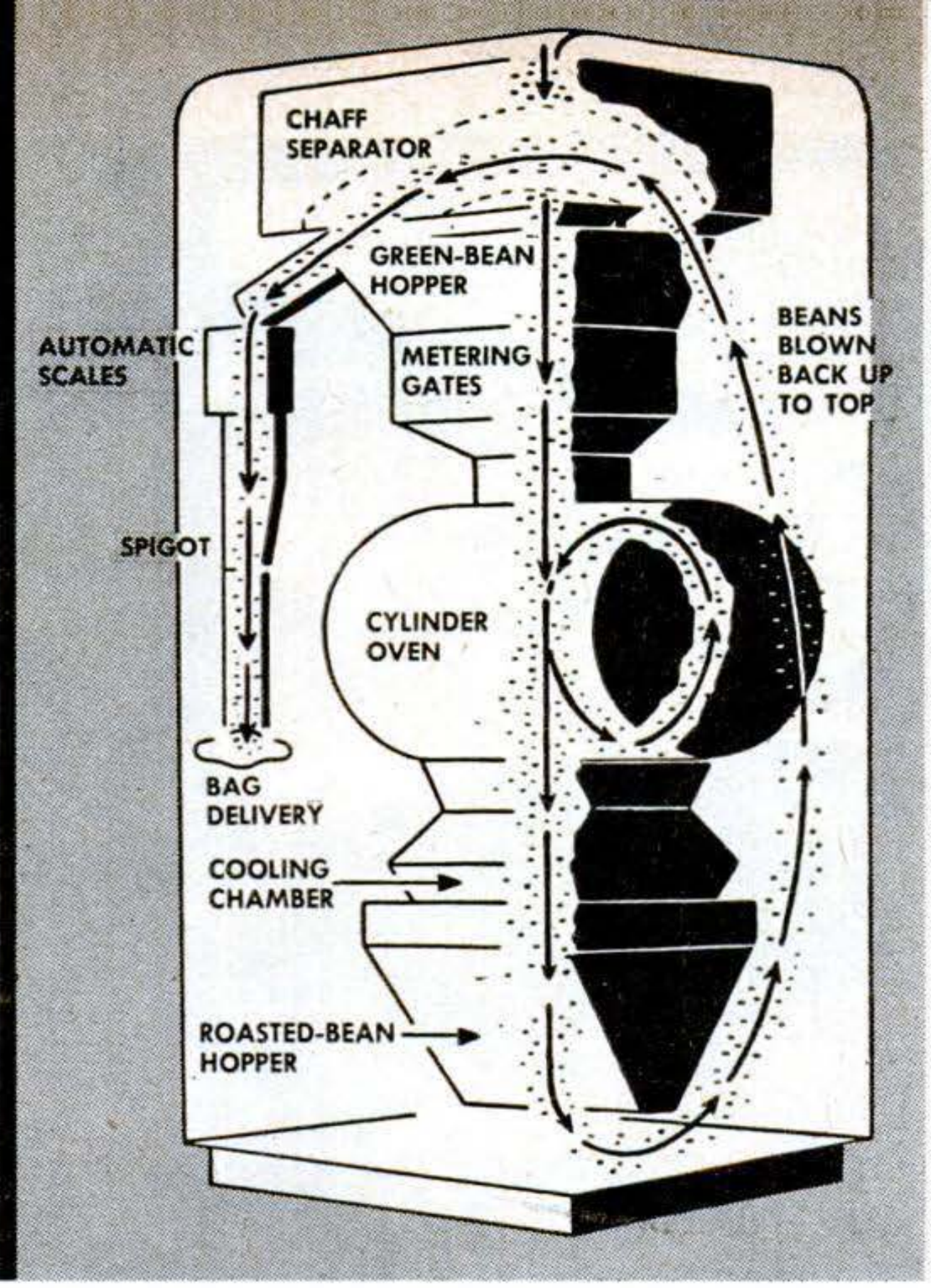
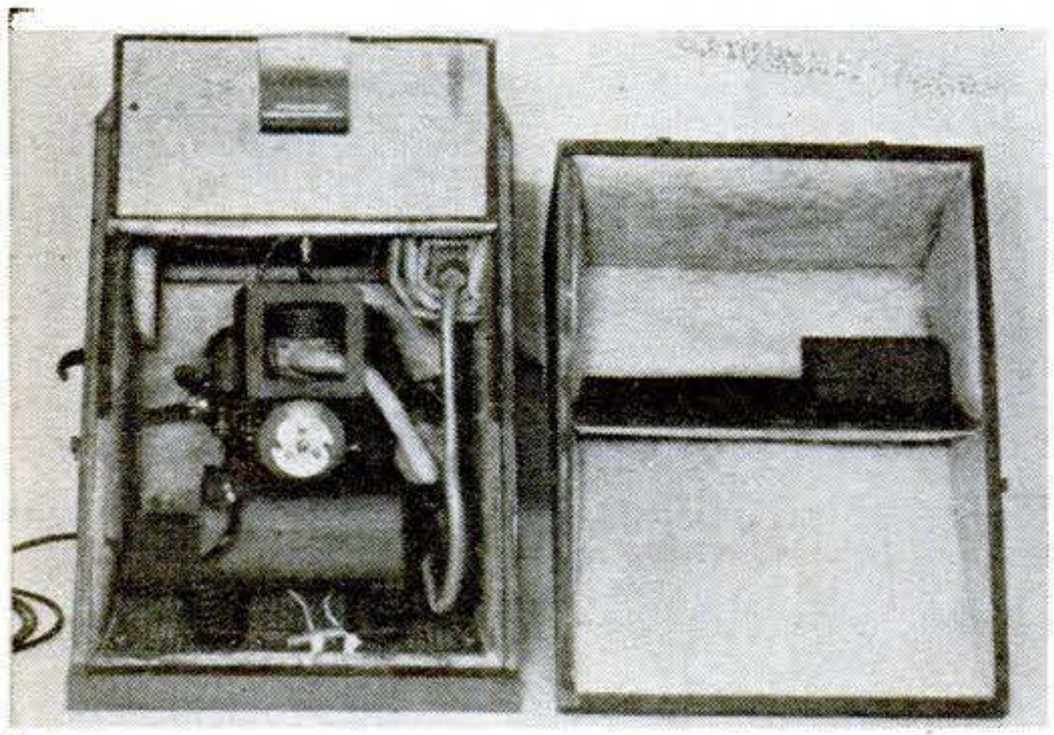


Machine Vends Roasted Coffee

When you get your coffee out of this machine, you're sure it's fresh—roasted right before your eyes while you wait. The Infra Roast® holds 150 pounds of green coffee and dispenses it, freshly roasted, at the rate of a pound a minute. The coffee goes first into a cylinder oven (see sketch at right above). There it is roasted by heat from infrared lamps controlled by a photoelectric unit that judges when it's done by how much radiation the beans reflect (PS, Nov. '46, p. 214). It next falls into a cooling chamber and then into a hopper. As needed, it is blown up and across the top where the chaff is removed. Scales then measure out an even pound into a bag.



Glass Wool Muffles Generator

Beyond 100 yards, you have to listen hard to hear this new 1½-kw. engine-generator above the chirp of a cricket. A labyrinth-like housing with a one-inch lining of Fiberglas® absorbs most of the noise. For front-line military use, the generator was designed by the Engineer Research and Development Laboratories, Fort Belvoir, Va.

TV Set Has Chairside Control

This new RCA Victor projection-type television set features a remote-control box that lets you adjust brightness and contrast without leaving your chair. Usually available in the past only as custom equipment, the unit, with its connecting cord, permits continual adjustment of these controls from up to 25 feet from the set.

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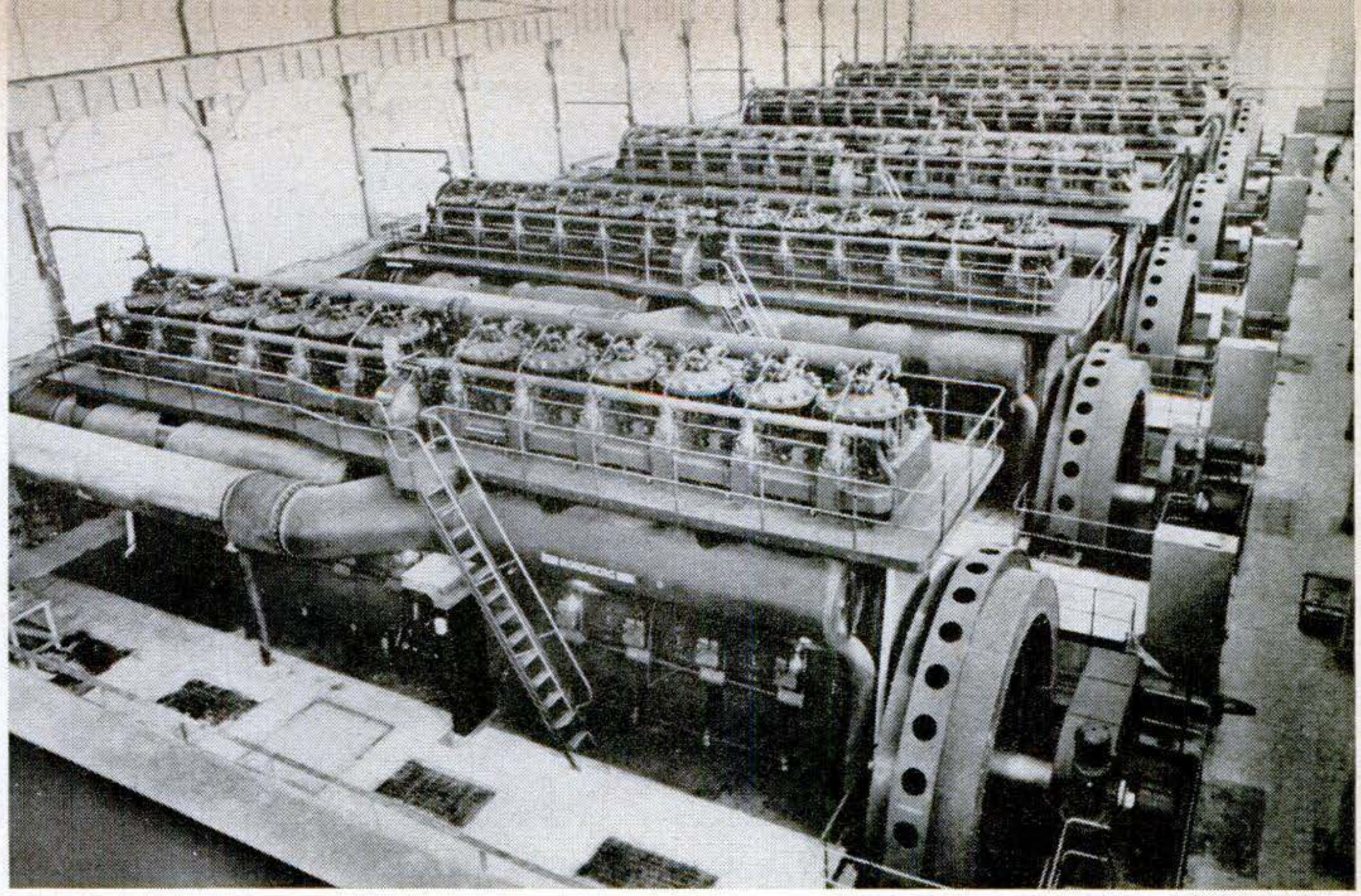
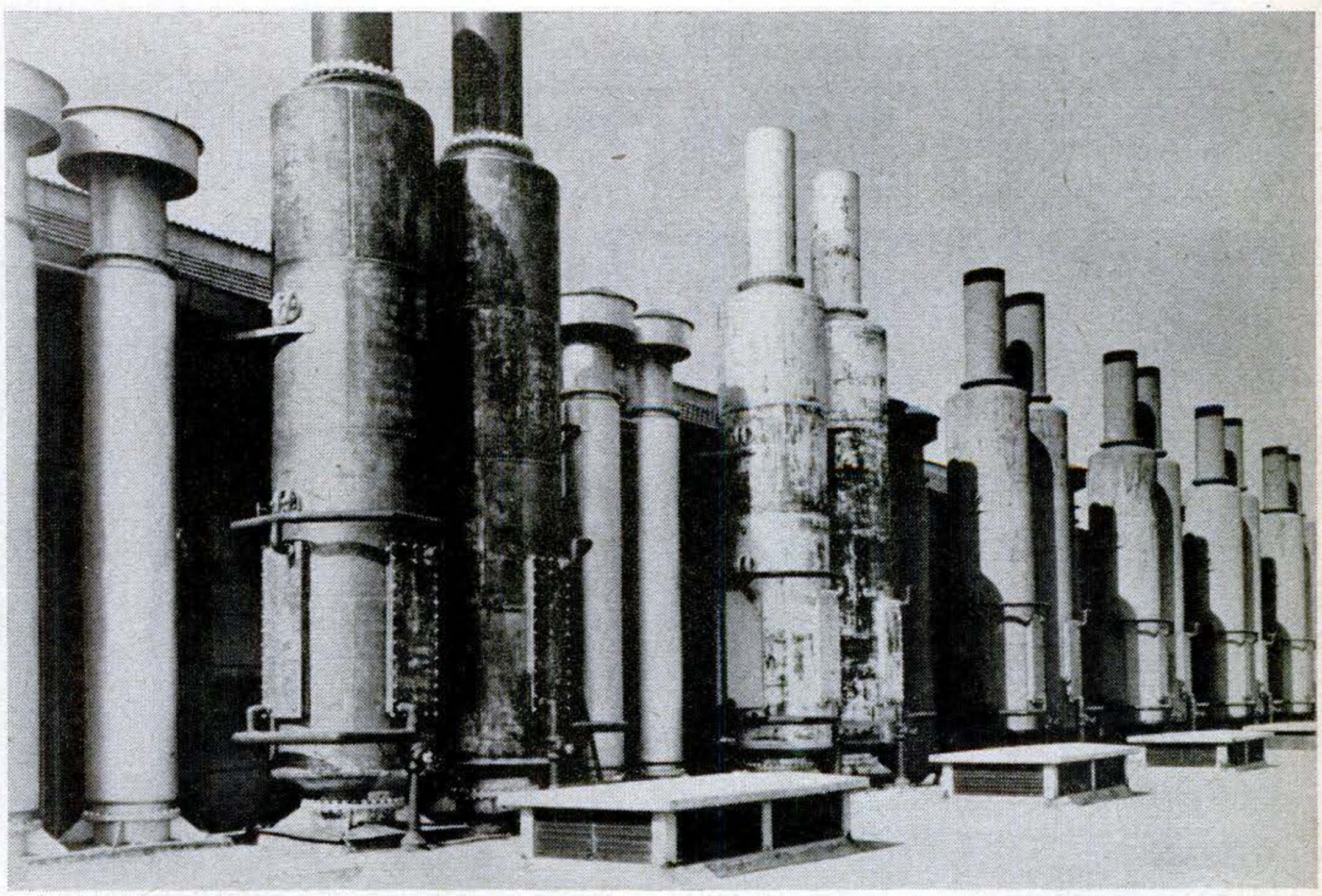


Walkways indicate size of engines, 268 ft. long, generating electricity at new Mexico City plant.

Mexico Gets Giant Diesel Generators

SIX of the largest Diesel engines ever built in the Western Hemisphere are now generating electricity for Mexico City. The new Tacubaya plant has a string of Nordberg Diesels each producing 7,350 hp., or 5,150 kilowatts, at Tacubaya's 7,600-ft. altitude. Each has 12 cylinders of 29-in. bore, with a crankshaft weighing one ton per foot of length. Heavy Mexican oil, centrifuged and heated before use, fuels the engines.



Air intakes and exhaust mufflers are big, too. They are atop building housing all six engines.

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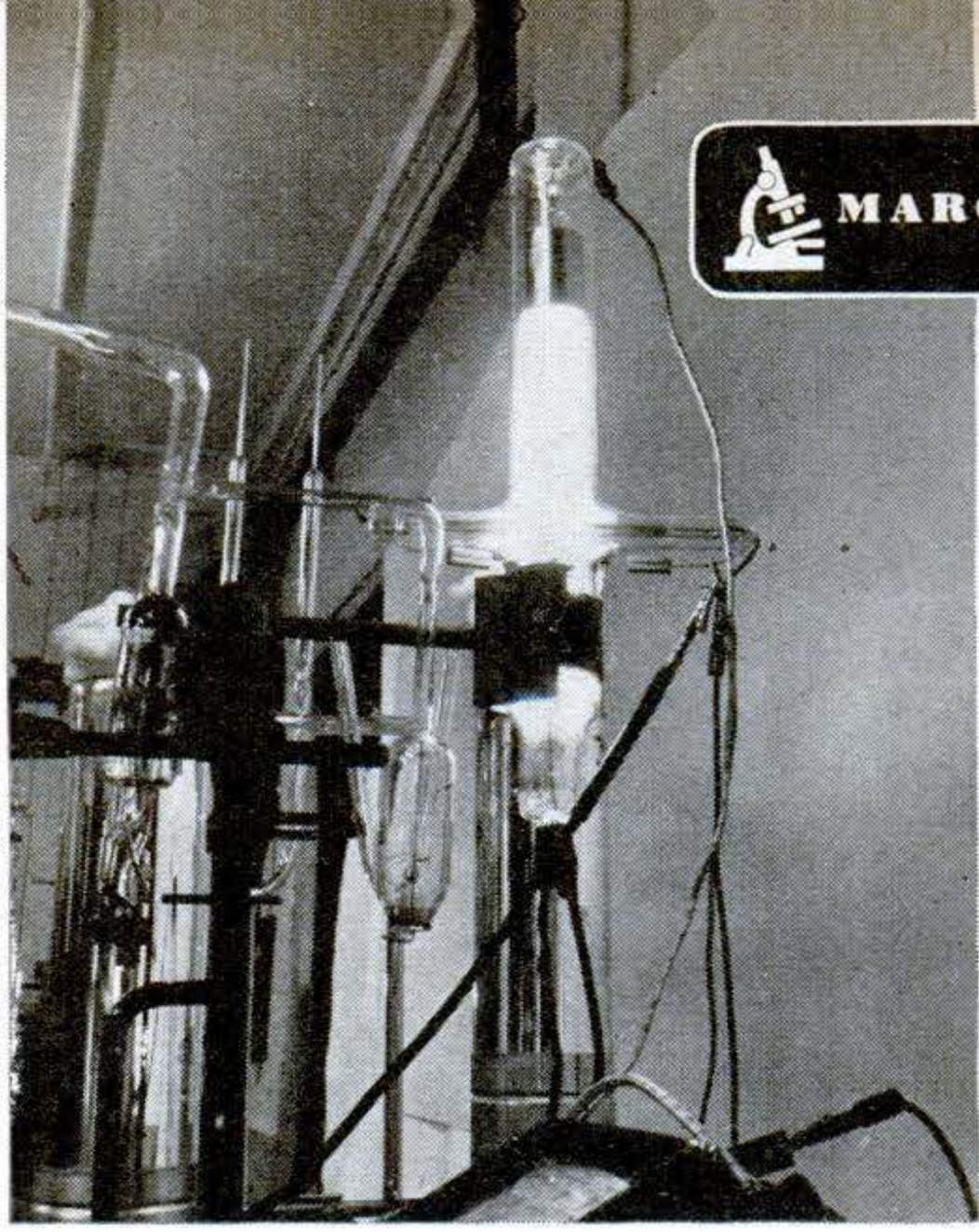
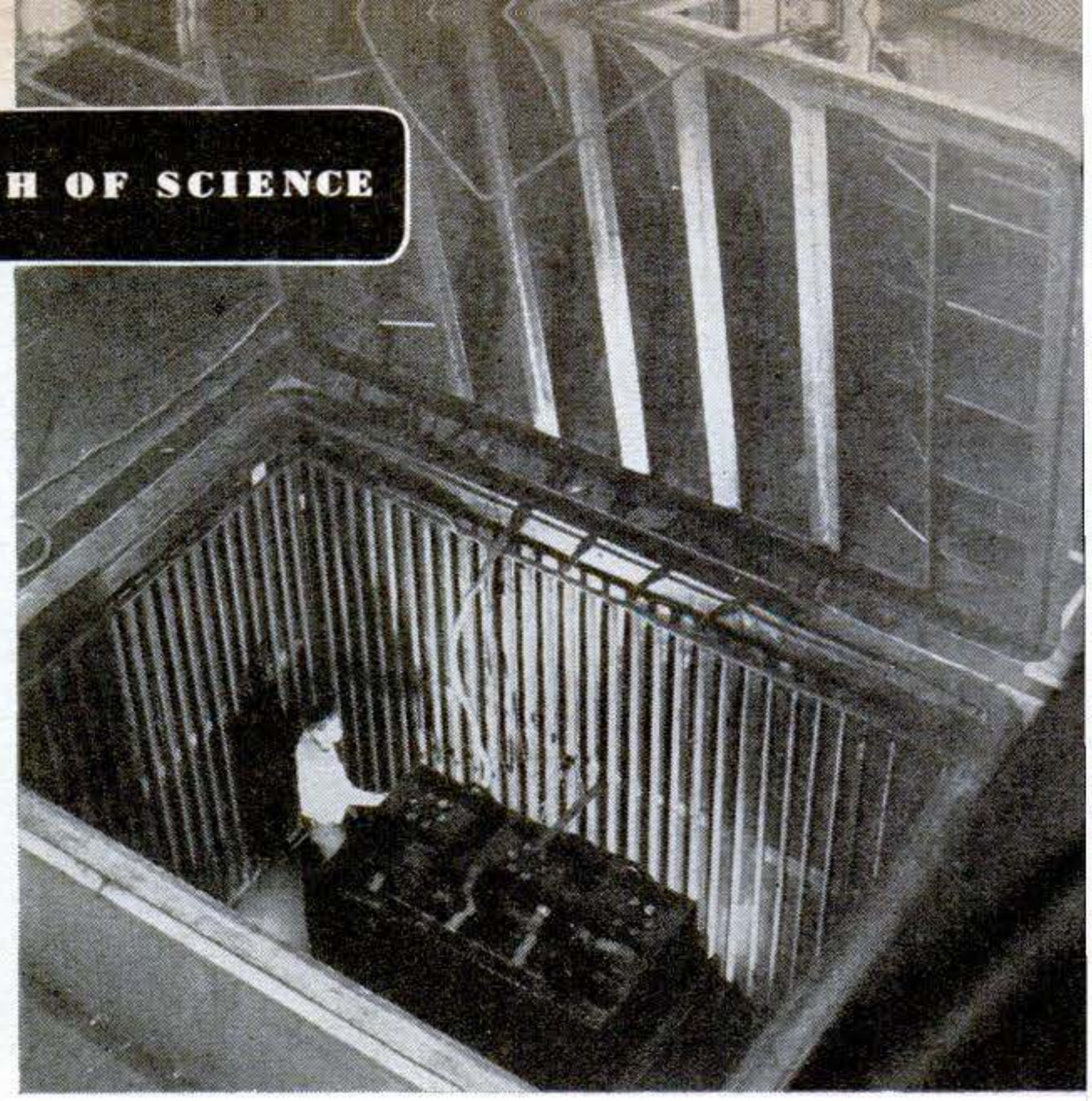
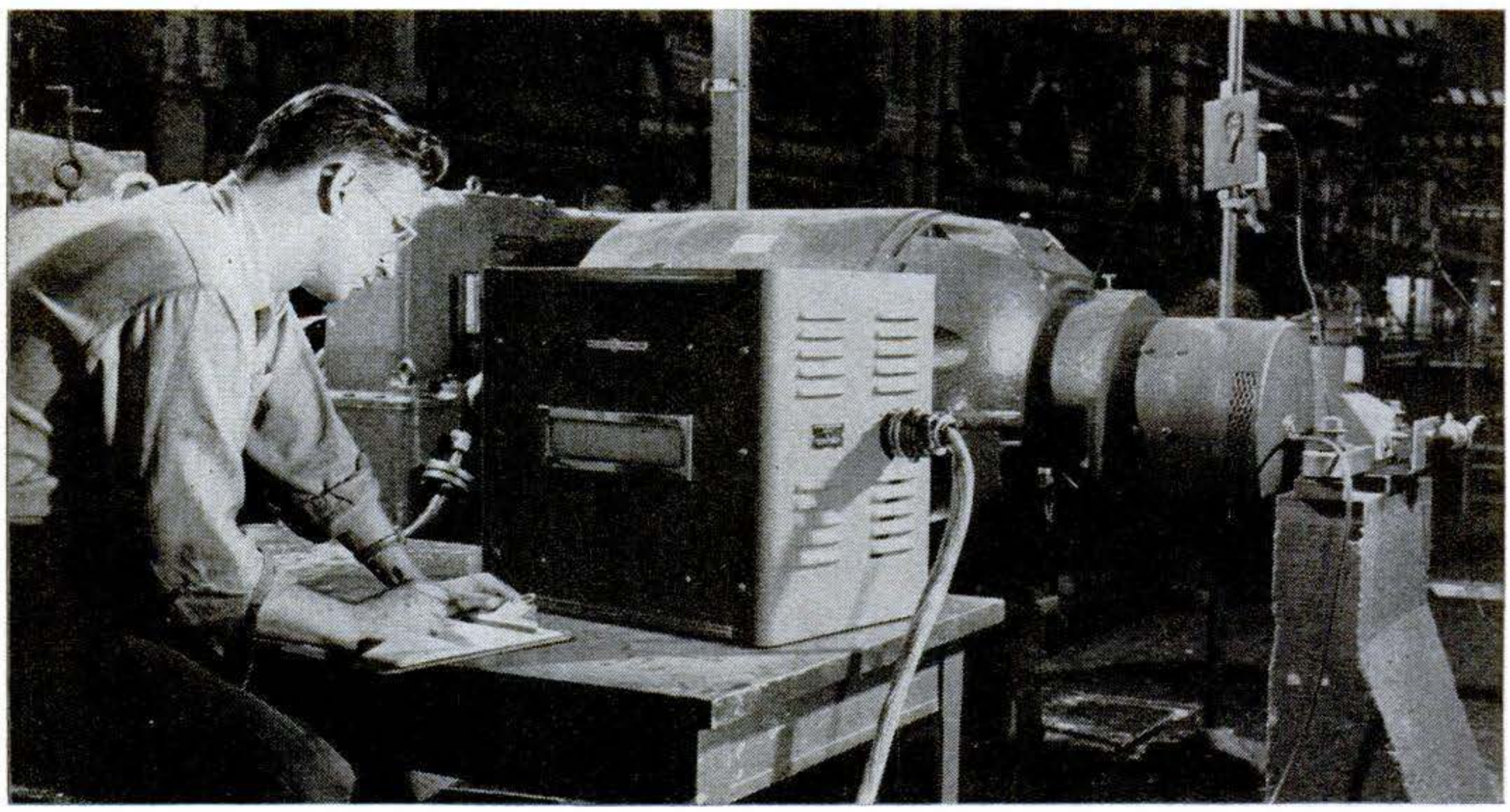


Vanishing Gas Traced. The fiery cross of gas above may lead to better electronic tubes filled with neon, argon, and helium. Their life is now limited because the gas gradually disappears as it is absorbed and permanently trapped in metal parts. By studying the unwanted effect with a tantalum probe in this experimental tube, National Bureau of Standards experts hope to find improved materials that will reduce it.



Tank Dunks Transformer. To assure perfect insulation for its windings, a high-voltage transformer core gets a dunking in oil in a huge vacuum tank like the one above at the Sunnyvale, Calif., Westinghouse Electric Corp. plant. After the air is drawn out, 10,000 gallons of insulating oil flow in, penetrating every pore in the coil covering. Finally, excess oil is drained and the 10-ton lid raised for inspection.

R.P.M. Counter. Speed of the rotating shafts of steam turbines and other machinery is measured to within one part in 15,000 by a new General Electric precision tachometer. Driven by the shaft under test, an AC generator in the instrument delivers current whose frequency increases with speed. The frequency is translated into revolutions per minute by electronic circuits. These circuits light bulbs to flash a six-figure number once every second on the frosted-glass screen in the photo below.



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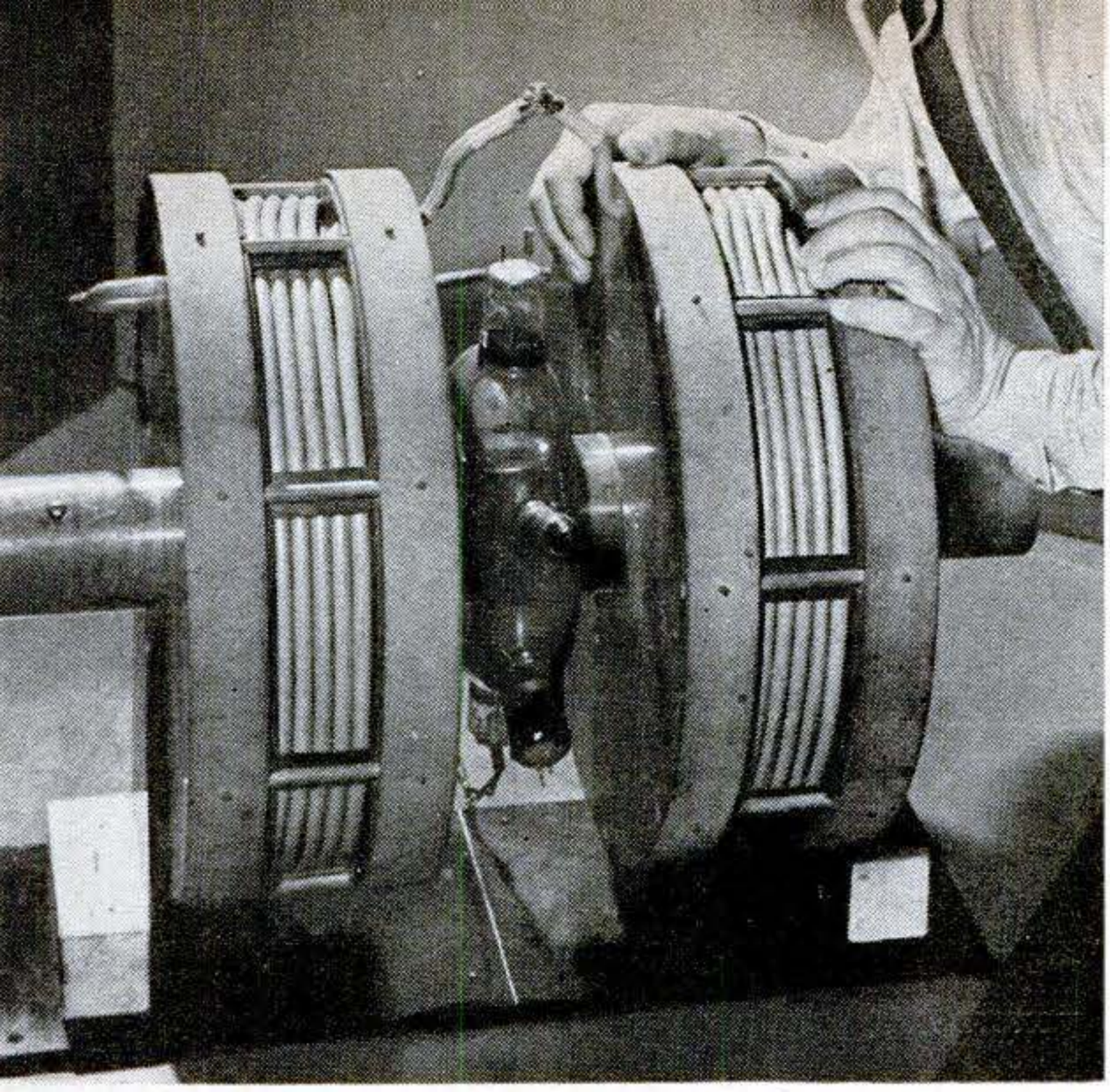
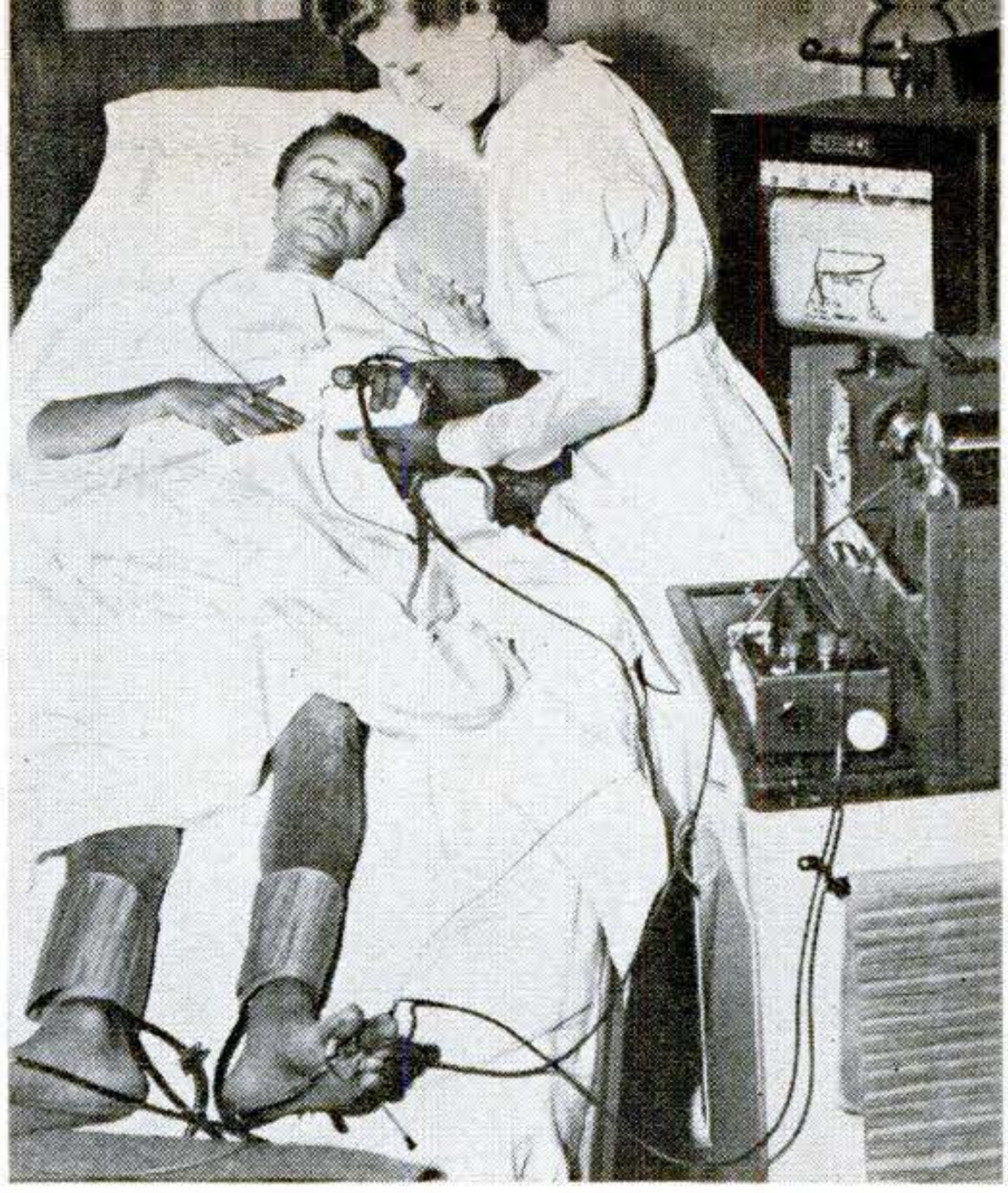
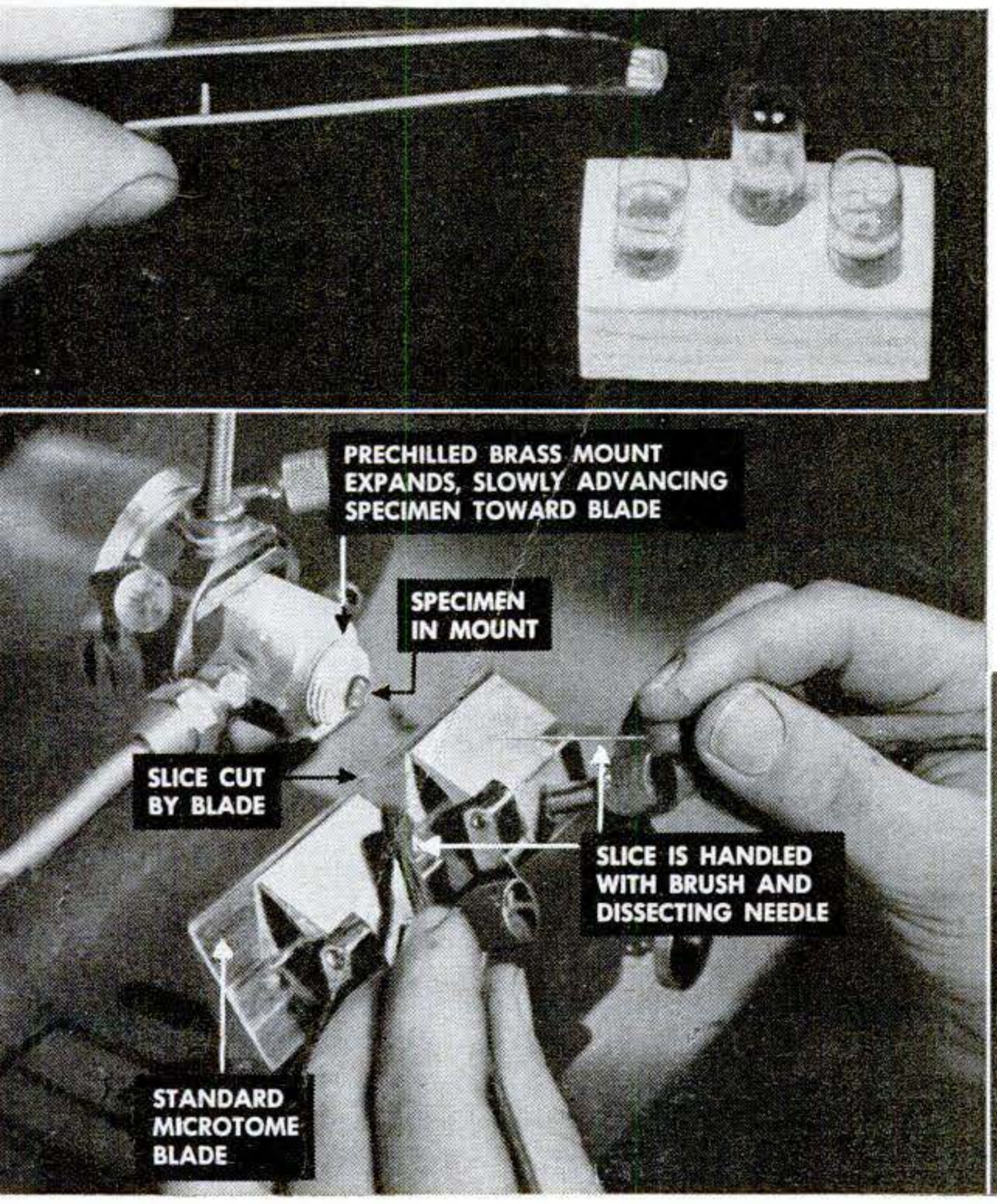


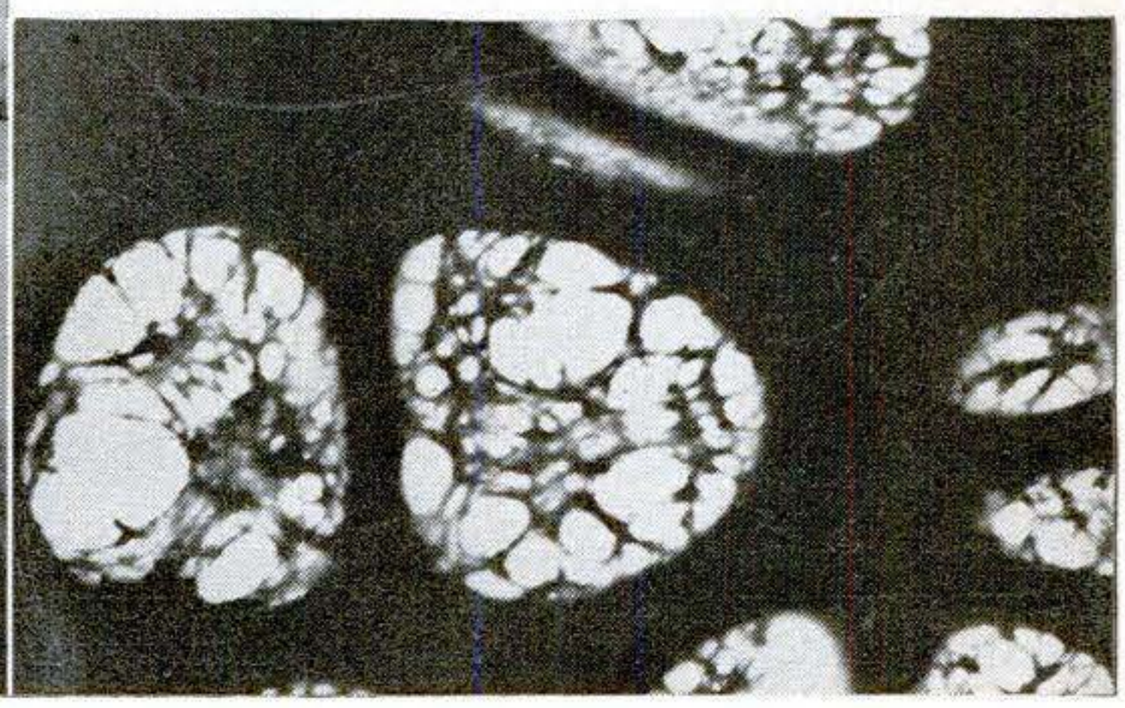
Baby Betatron. A midget among atom smashers, this 110-pound betatron packs a 9,000,000-electron-volt punch. Resembling a new GE 300,000,000-volt betatron (PS, Aug. '49, p. 148) in dispensing with a massive iron yoke, it stands at the opposite end of the size scale. It serves as a portable experimental tool in the Philips Research Laboratories at Eindhoven, Holland. A "doughnut tube" shows electron paths.



Toe Tester. Second-to-second changes in the sizes of fingers and toes are measured by the device above. Blood pulsing through a digit dilates it enough to displace air in a plastic cup attached to it. This records a wavelike graph on moving film in a sensitive Brown Instruments recorder. The device, named a plethysmograph, from a Greek word meaning "an enlargement," helps doctors diagnose heart ailments.



Ultra-Thin Slices. Any worker now can slice tissue—such as the frog's-eye section below—thin enough for an electron microscope's beam to penetrate it. In an ingenious method developed by the National Bureau of Standards, the specimen is first placed (left) in a capsule of liquid plastic. Heated, this solidifies, embedding the specimen. Then it goes in a brass mount (lower left) chilled by carbon dioxide gas expanding through a needle valve. As the mount returns to room temperature, its expansion moves the plastic-held specimen less than .000039 in. under the blade.



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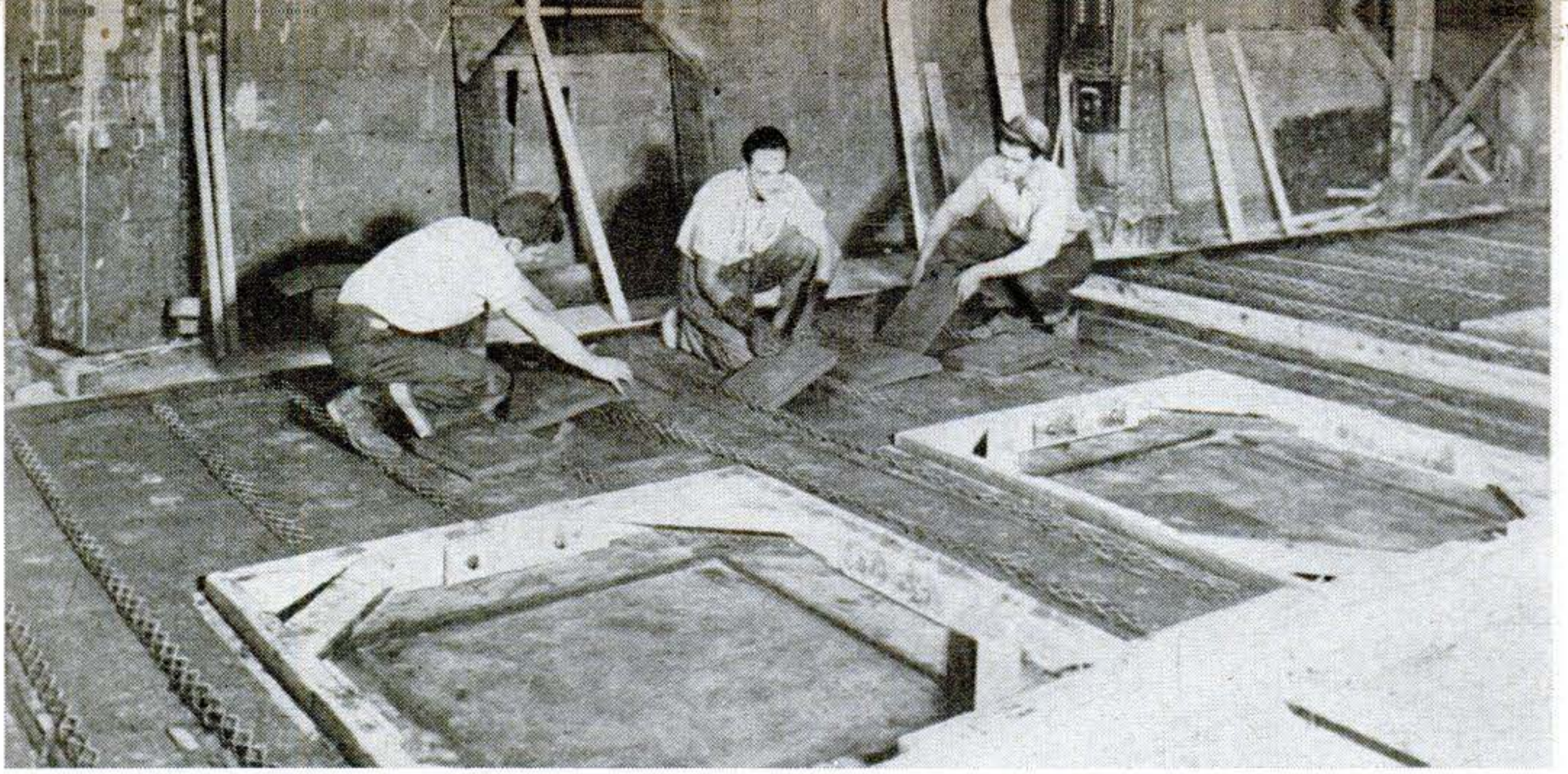
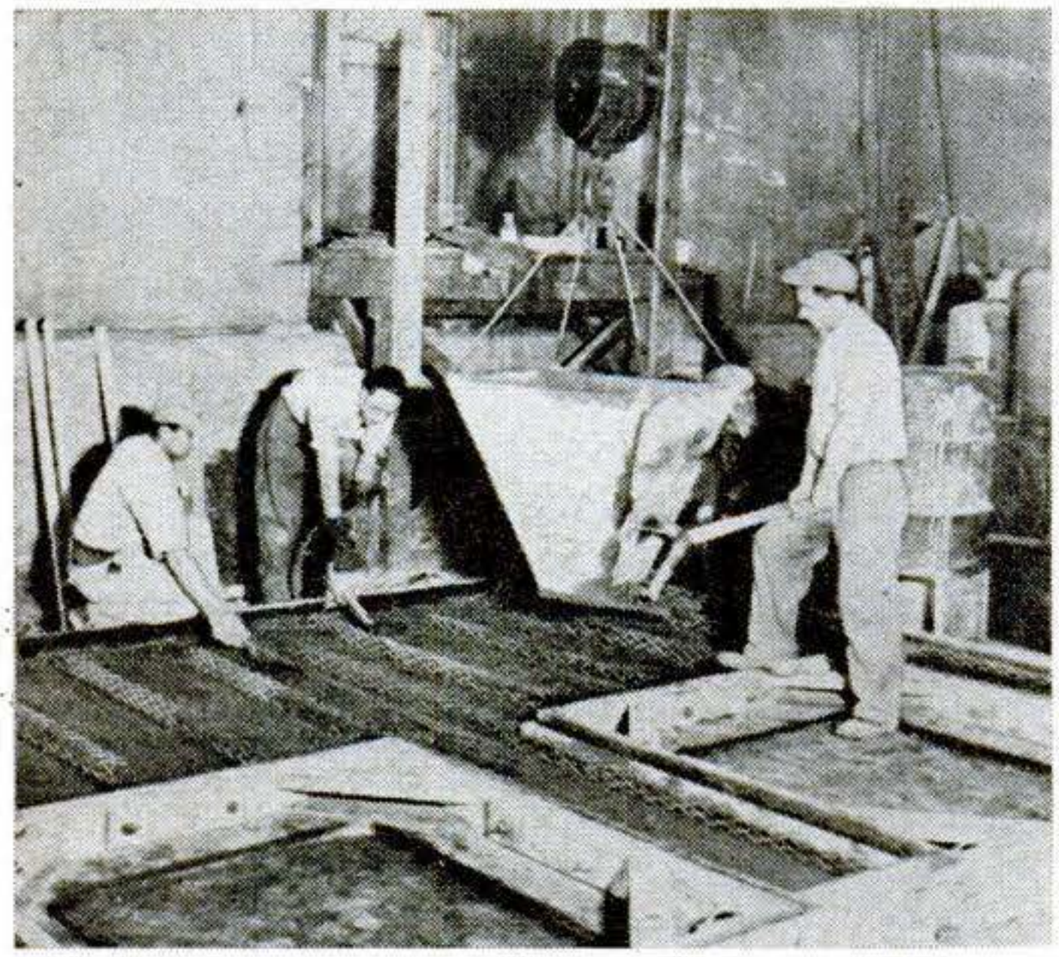


Blocks of Foamglas® form the insulating core of this new concrete-and-glass building panel. They are laid (above) after the first concrete veneer has been poured into the wooden form.

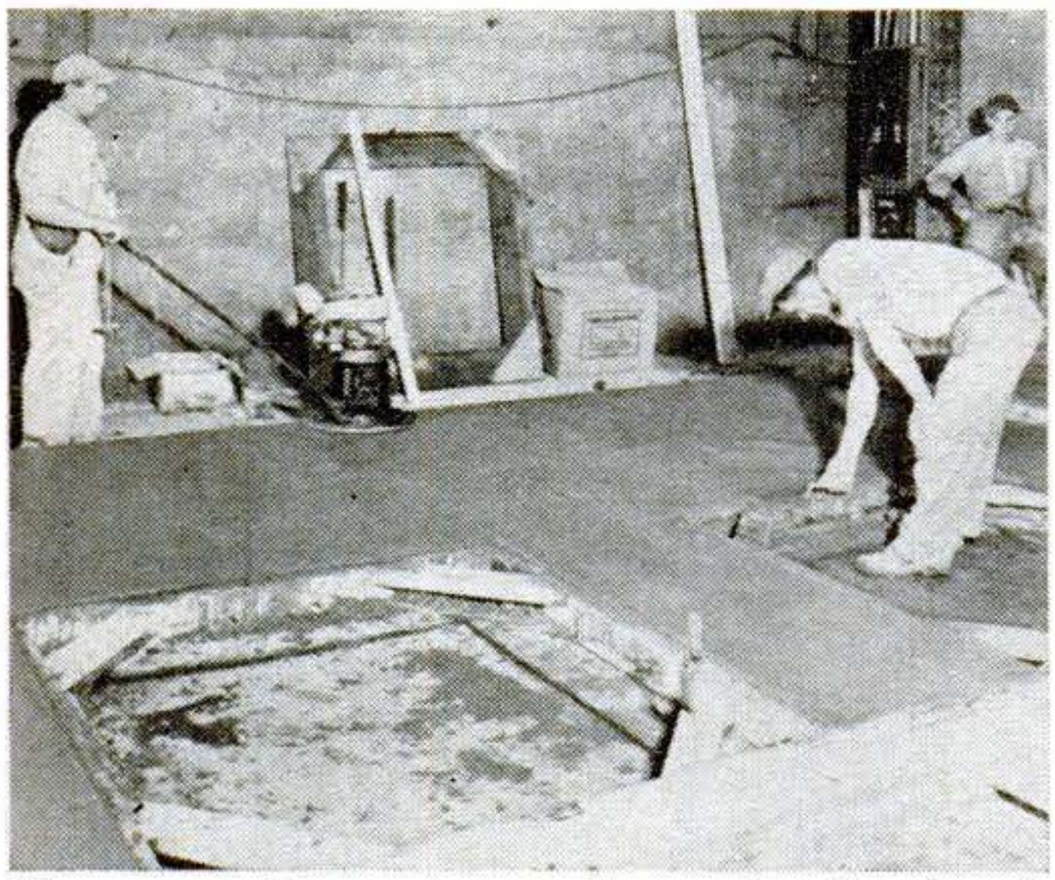


Pouring of second concrete layer is the next step (above). Each of the three layers in the "sandwich" is two inches thick, making a wall about half as thick as ordinary masonry walls.

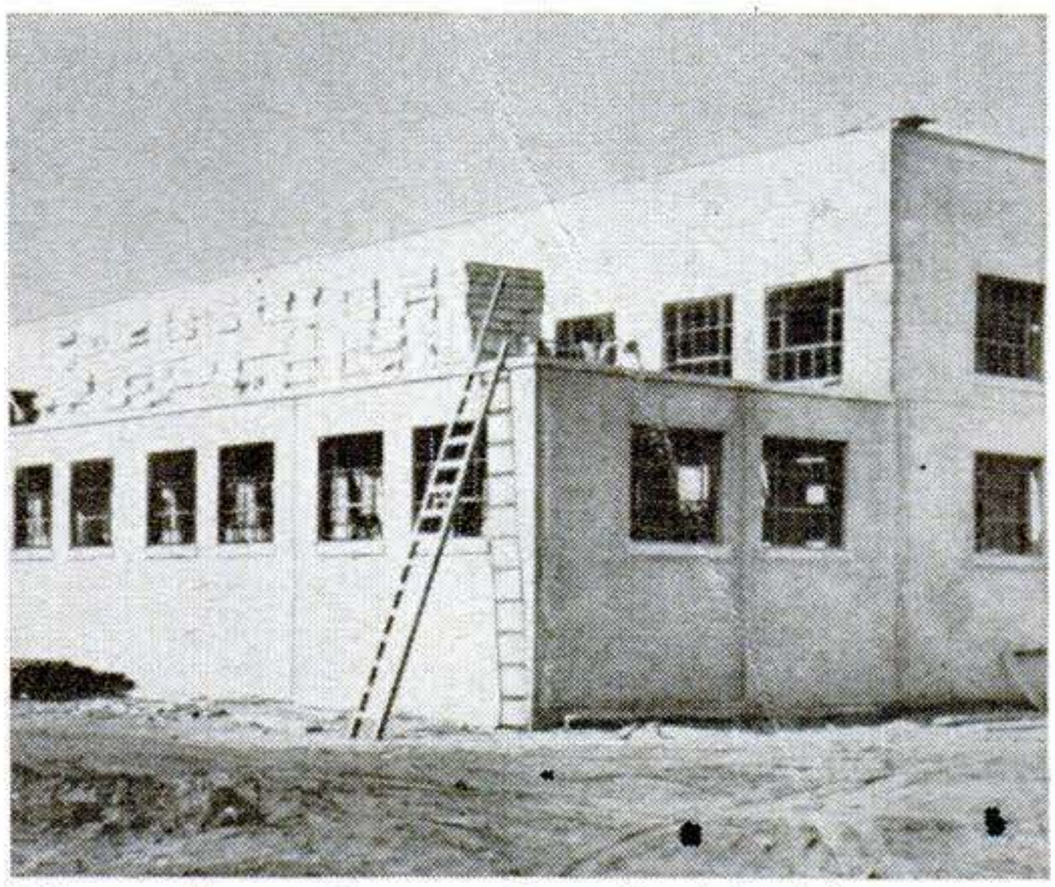
Glass, Concrete Make Wall Panels

GLASS is being used in a new kind of wall that is thinner and cheaper, yet offers better protection against weather. The new walls are sandwich panels, made of concrete with a "filling" of foamed-glass bricks.

The concrete-glass sandwiches can be made on the job in panels of any practical size. A layer of concrete is first poured in a flat form, the Pittsburgh Corning Foamglas® blocks are placed on it, and the second layer of concrete poured. One day later the panels are ready to be fastened to the building frame. While used first for "curtain"—non-load-bearing—walls in industrial structures, they're now being tested for use in homes.



Heavy mechanical troweling plus handwork complete the job. The exterior concrete veneer gets its finish at this point. The interior veneer can either be finished or prepared for plaster.



The wall panel is ready to be lifted by a crane and fastened to building framework 24 hours after concrete is poured. Building above is walled almost exclusively with these panels.

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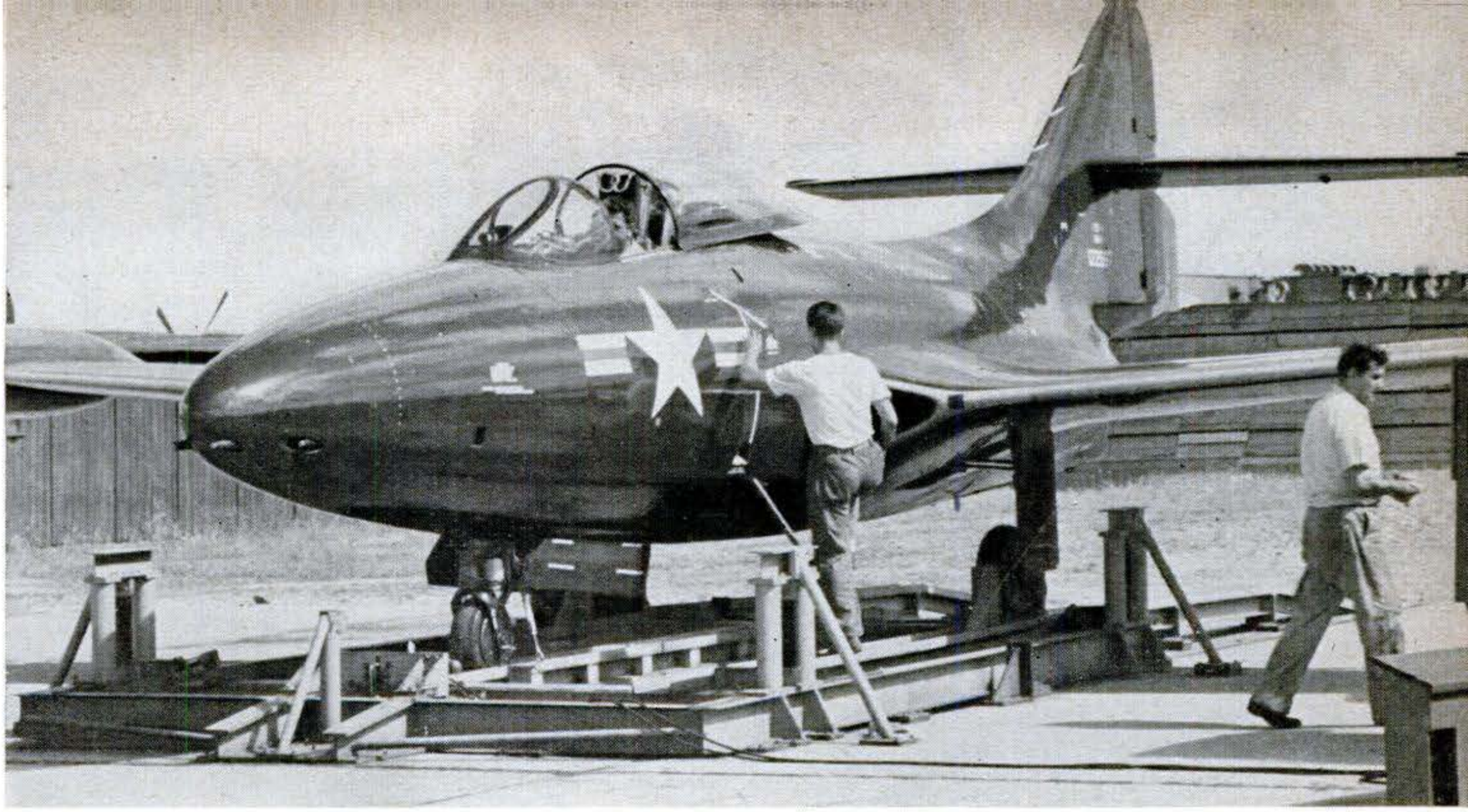
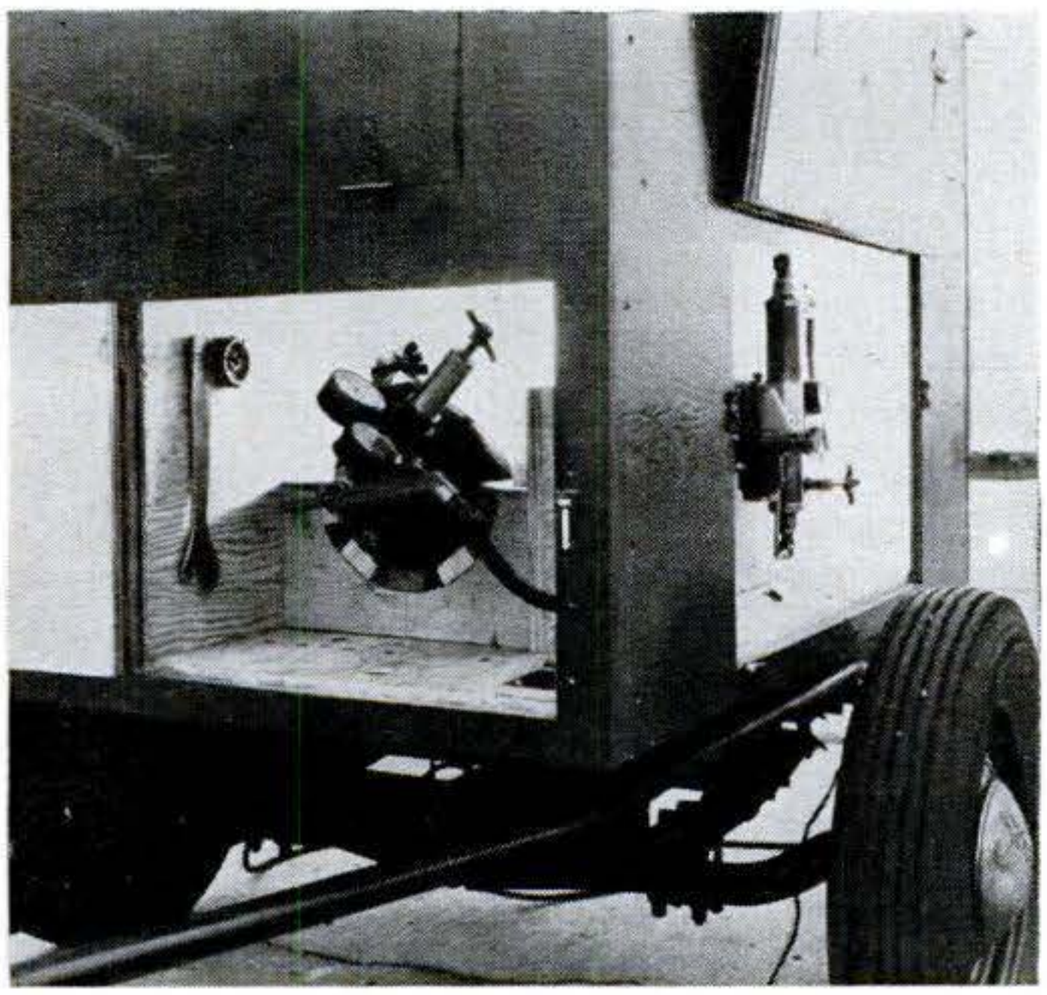
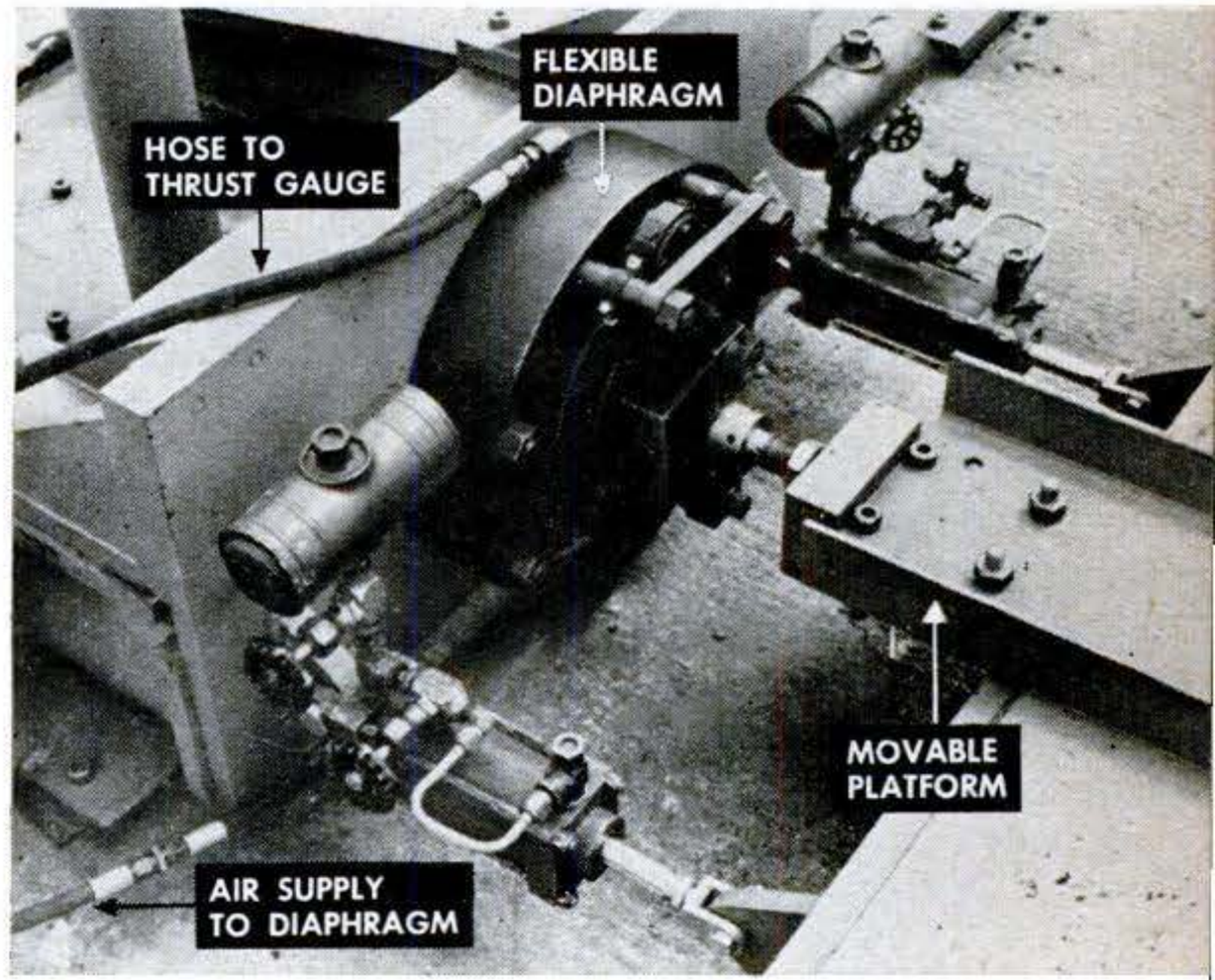


With pilot in the cockpit, the Panther carrier-based jet fighter above is on the stand being readied for a routine thrust test. Its power plant is a Pratt & Whitney J-42 jet engine.



Compressed-air bottle and gauge for the measuring system are mounted in this trailer. One hose supplies air to the ThrusTorq® diaphragm; another hose leads back to the reading gauge.



Close-up view above shows the ThrusTorq®, the large cylindrical unit in the center. Dampers flanking it minimize lateral movement of the platform on which the jet aircraft stands.

Platform Scale Feels Jet's Muscle

HOW to measure a jet's thrust—the equivalent of horsepower in a piston-engined plane—without actually flying the plane has been neatly solved by Grumman engineers. They literally put the plane on the stand—a new device called a thruststand.

The plane is towed up a ramp and imprisoned on a movable platform. As the engine is started, it thrusts forward according to the speed of the engine. But instead of taking off, it exerts this thrust against one side of a flexible diaphragm in a Hagan ThrusTorq® meter. At the same time, just enough air pressure to balance the thrust is applied to the other side. The amount of air pressure needed is thus a direct measurement of the thrust.

The new system also enables the engineers to check and calibrate the jet plane's own thrust-measuring instruments.

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1. COAL PREPARATION
2. PASTE PREPARATION
RECYCLE COMPRESSORS
9. FINAL DISTILLATION
8. VAPOR-PHASE CONVERSION
3. HIGH-PRESSURE PUMP HOUSE
CONTROL ROOM
4. LIQUID-PHASE PREHEATING
5. LIQUID-PHASE CONVERSION
6. FLASH DISTILLATION
HIGH-PRESSURE PIPES
7. VAPOR-PHASE PREHEATING
HEAVY-OIL STORAGE

Steps in process of hydrogenating coal to gasoline are outlined in plant model (above).

Coal goes through these stages (below) before it changes into fuels shown on bottom shelf.

LUMP COAL

CRUSHED COAL

PULVERIZED COAL
DRIED 60 MESH

PASTING OIL

COAL PASTE
48 PARTS COAL
52 PARTS OIL
00.3 PARTS CATALYST

MIDDLE OIL
HEATING OIL
VAPOR PHASE

JET FUEL

DIESEL OIL

GASOLINE
VAPOR PHASE

U. S. Starts Making Gasoline From Coal

Missouri plant turns out 200 to 300 barrels a day by squeezing hydrogen into coal under terrific pressure.

AT LONG last the United States has begun tapping its vast coal resources for synthetic gasoline.

From 200 to 300 barrels of gasoline are being produced daily at a demonstration plant built and operated by the U. S. Bureau of Mines. It wrings gasoline from coal by an improvement on a German process.

The implication is plain: if the nation's oil were suddenly to be exhausted tomorrow, our internal combustion engines need not want for fuel. A supply would come as fast as coal-processing plants could be built. Our coal reserves are almost incredibly big—coal occurs in 30 of the 48 states. We probably would supplement coal gasoline with oil-shale gasoline (PS, Feb. '49, p. 130).

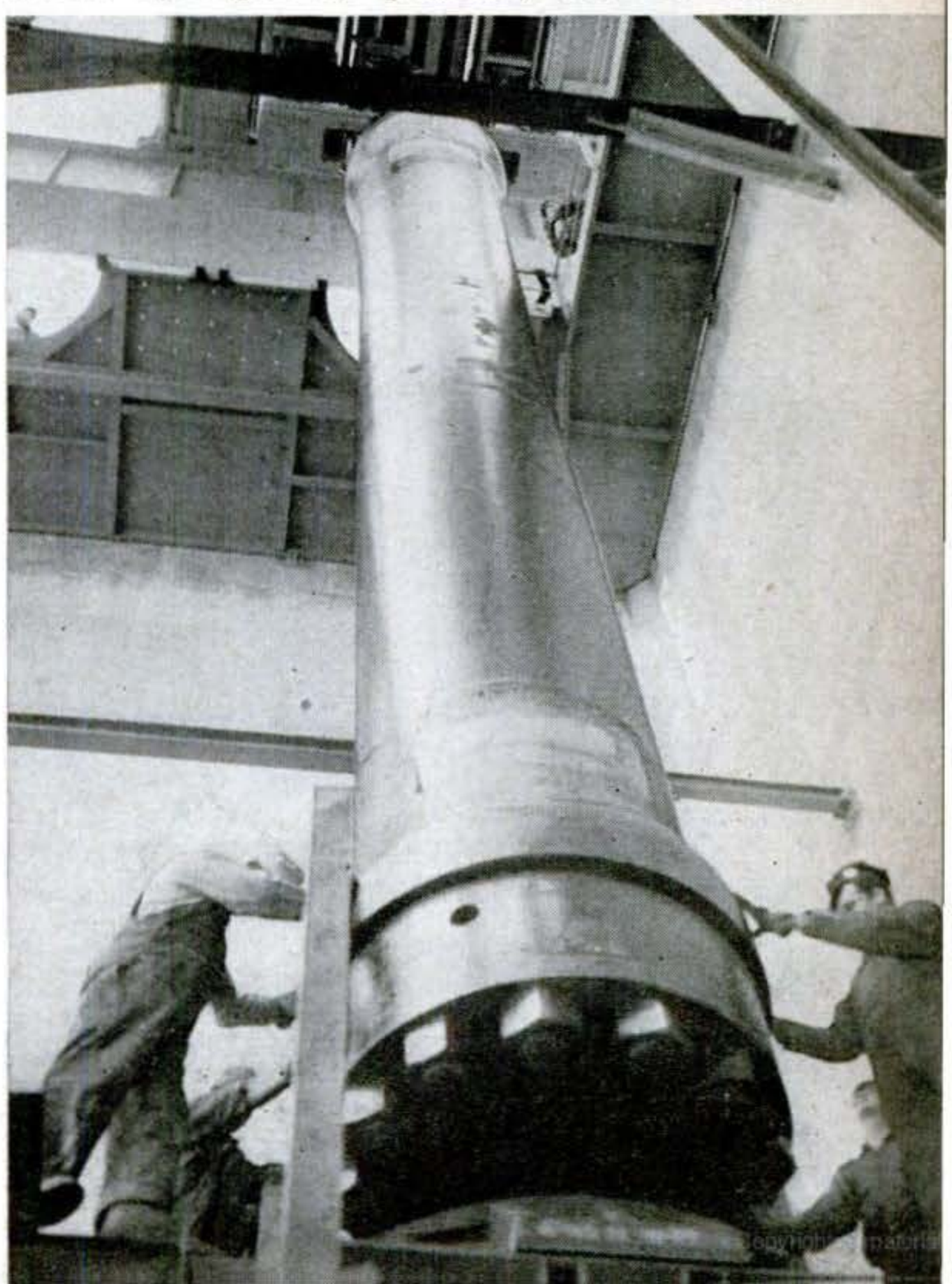
The coal gasoline now being made in Louisiana, Mo., is a pittance compared to the daily U. S. consumption. Yet it is the first we have produced in quantity.

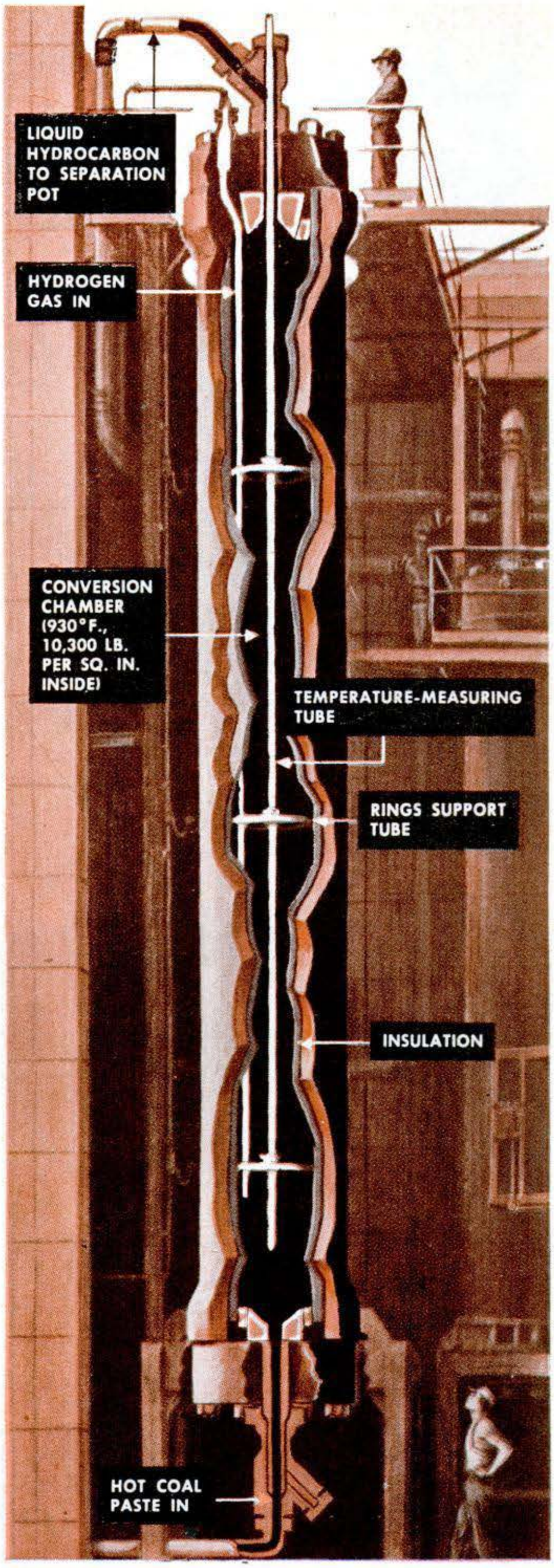
The gas is of good quality. In octane (anti-knock) rating it can be made to equal the motor and Ethyl®-containing grades that you can buy currently at the corner filling station.

The cost? Well, today's oil-refinery price for gas is 10 to 12 cents a gallon. That includes profit and other business items.

Those are nine-inch nuts holding the top on one of the liquid-phase converters at the Louisiana, Mo., synthetic plant. The giant nuts are needed because of the tremendous pressure inside the converter—10,300 lb. per sq. in.

Concrete safety shielding can be seen in this view of converter from below. Inside the heavy steel vessel, paste—made by crushing coal and mixing it with oil and catalyst—is forced to absorb hydrogen by pressure, 930° F. heat.





Construction of converter, in which coal is made into petroleumlike hydrocarbon by addition of hydrogen atoms, is shown in cutaway above. The coal paste, entering at bottom, passes through two such tanks, leaving as a liquid. Another similar tank handles it as a vapor, adding more hydrogen, before gasoline is obtained.

Gas made in the demonstration plant costs from 8 to 15 cents a gallon, without profit or business expenses depending on the price and properties of the coal. Large-scale production might cut that.

There are two ways to get gasoline from coal. Either provides other products too: heavy oils, Diesel oil, jet fuels, and so on. Germany developed both processes. One, the Fischer-Tropsch, uses carbon monoxide, the same odorless and lethal stuff that streams out auto exhausts, and hydrogen.

The other is the Bergius process, the hydrogenation of raw coal. It makes coal accept additional hydrogen until it is like petroleum hydrocarbons.

The principal difference between petroleum and coal is molecular structure and hydrogen content. The experts' problem is that of making coal (impure carbon containing some hydrogen) take more hydrogen and, breaking down, become in part a synthetic hydrocarbon. Petroleum is a natural hydrocarbon. So are natural gas, paraffin, India-rubber, turpentine, certain essential oils, and some coal distillation products.

To Try Other Process

To make gasoline from coal, the laboratory people want first to produce something consisting of one part carbon, and two parts hydrogen—as chemists say, C_nH_{2n}. The "n" here merely stands for a quantity. The important point is the *relative* amounts of the elements present. This C_nH_{2n} can, like crude oil, be distilled to give gasoline and other things.

The plant now operating in Missouri hydrogenates coal. The Bureau of Mines pretty soon will also have a Fischer-Tropsch plant finished at the same site.

The bloodstream of the hydrogenation process for making gasoline is hydrogen. At the operating pressure of 10,000 pounds per square inch, three fourths of the pressure is exterted by hydrogen. Besides pressurizing and adding itself to coal, it sets temperature in the reaction vessels.

Hydrogen isn't made for free, and so it is captured here and there in the system after it has done its work, and then recycled. Since it can be highly explosive—especially under pressure—all manner of safety precautions are taken. The system is "closed." There are no holes except openings that let raw materials in and spigots that let intermediate and finished products out. There are steam snuffing lines everywhere.

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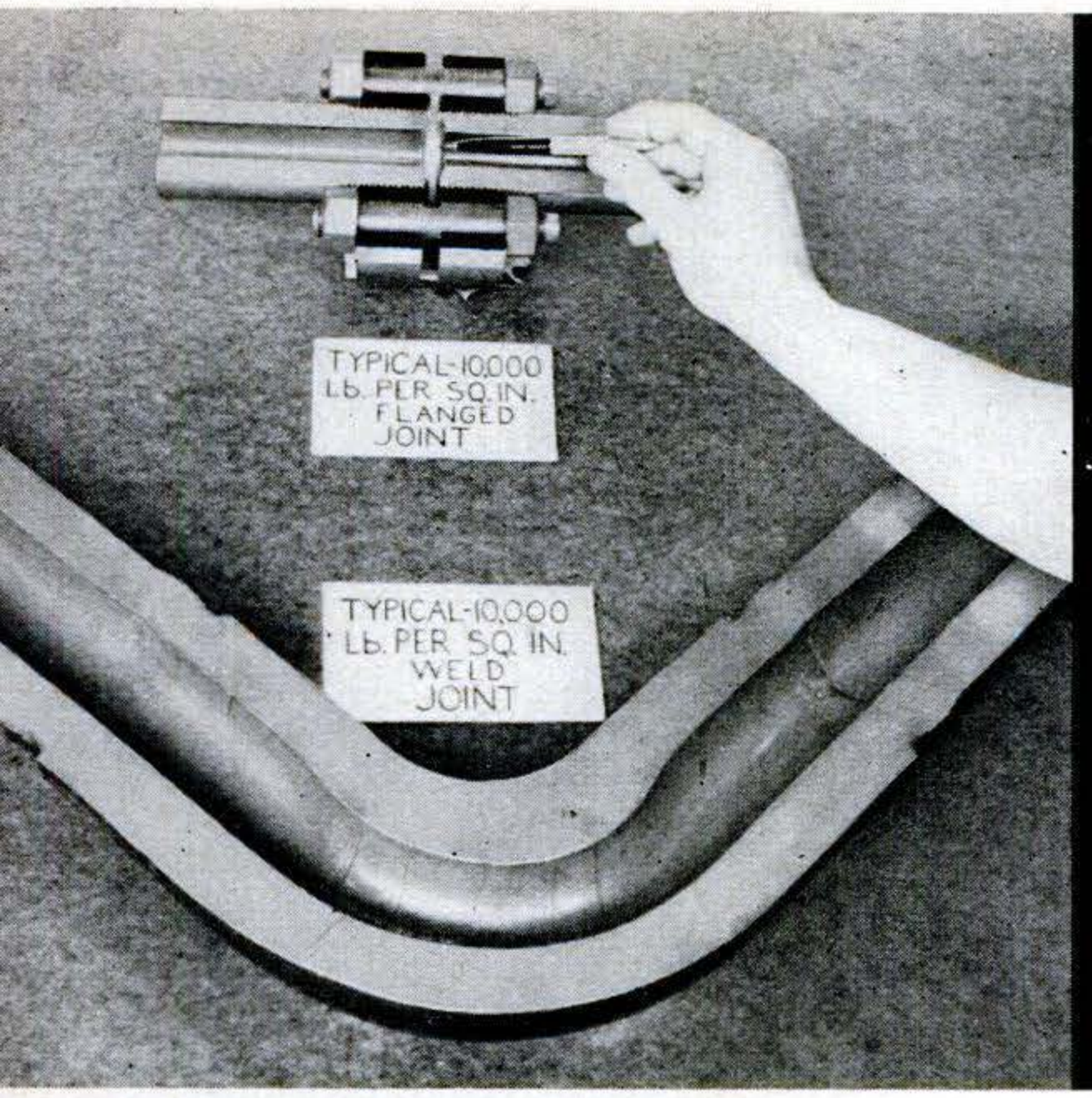
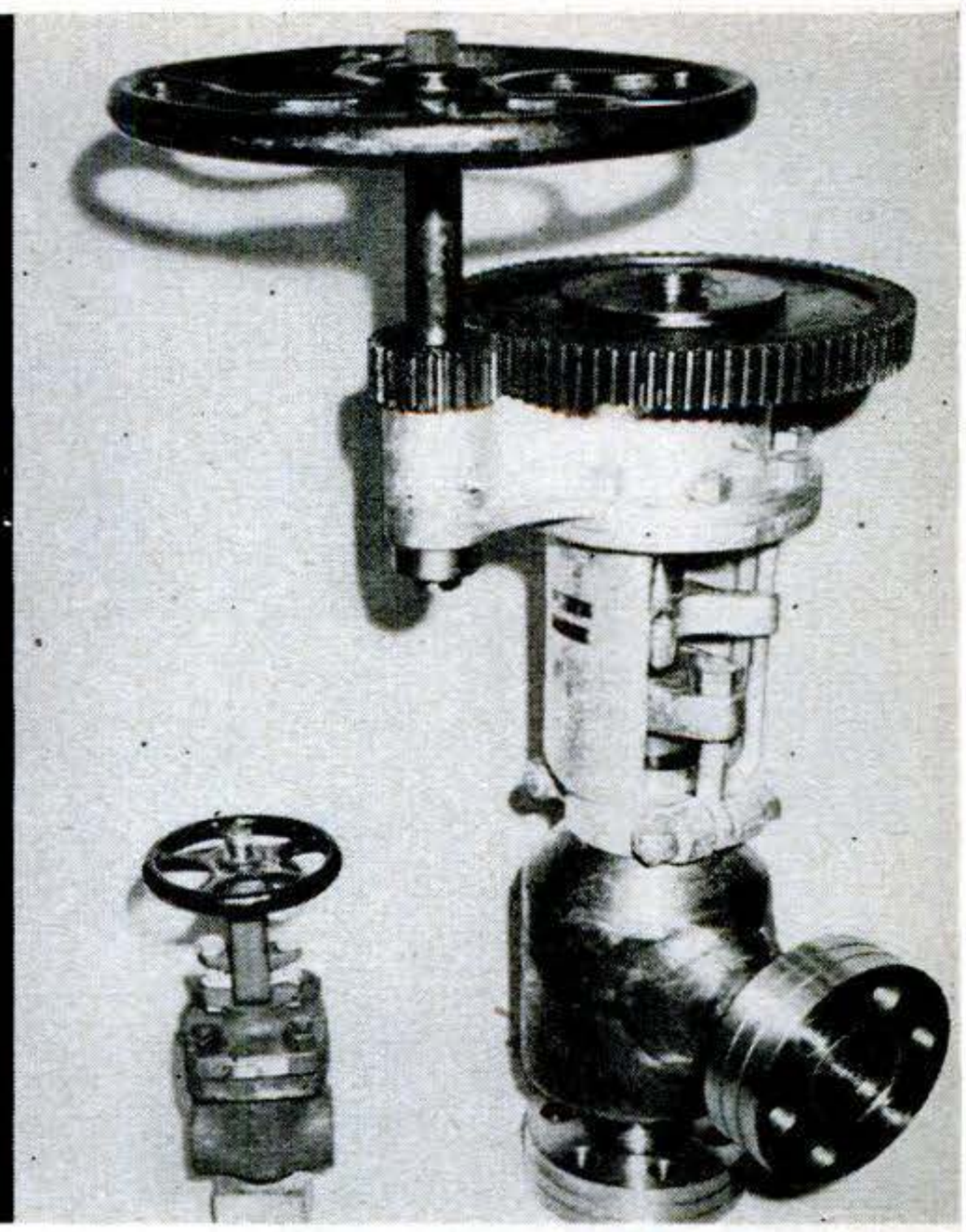


Super-plumbing. Pipes, among heaviest ever made, have special high-pressure joints. At top, sheet of pierced soft metal (at pencil tip) seals flange connection. Joint at bottom was welded.



It's not easy to turn off 10,300 lb. per sq. in. Compare the standard two-inch valve at left with the geared giant at right—also a two-incher—used in coal-hydrogenation process.

The synthetic gasoline produced is near 78 octane—a premium grade without tetra-ethyl lead. It can be further improved by slight changes in the process or by the addition of small quantities of tetra-ethyl-lead. Dr. L. L. Hirst, chief of the plant, doesn't know how much lead his gas will pick up. He hasn't tried adding it.

It takes about a ton of coal to make a little over two barrels of gasoline (85 gallons) or 2¼ barrels of Diesel oil.

The plant has been using a Wyoming soft coal, but probably will reach into nearby Illinois for future supplies. The Wyoming coal was chosen for initial work because reserves there are huge, Wyoming coal interests were anxious to see what could be done with their product, and it produced little ash or contaminating sulfur.

Making coal gasoline posed some new problems for American industry. Only after several cut-and-try attempts were pumps manufactured that could stand up under the punishment meted out by the mixture of oil and powdered coal. The secret lay in making plungers and valves very hard. That reduces abrasion to a minimum.

Two marked departures from the German method have been made. The German plants had several hand-operated controls. The human factor makes them dangerous. Our controls are almost wholly automatic.

The Bureau also felt that the Germans' convection method of preheating the coal paste would be too expensive. The U. S. method uses a direct natural-gas-fired heater and protects the paste-carrying tubes with a superheated steam jacket.

While the U. S. has made strides in hydrogenating coal, we certainly didn't do it alone. Seven German experts are right here in Missouri helping with the plant design. One was the assistant director of high-pressure research in synthetic fuels before Germany fell. Two were plant managers.

The new coal gasoline works all right. It has been used in official cars around the plant, and will be sold to other government departments. Although none is to be sold to the public, the other day a stranded taxpayer on the highway nearby got a pint or so. He must have known he was burning some weird concoction. For like all untreated gasolines, coal gasoline smells like fury.

It won't be hard to get rid of the smell. The real question is: can we depend on coal to supply all the gasoline and oils we need? Or must we find new ways to fuel our civilization? The plants at Louisiana should give the answer. END

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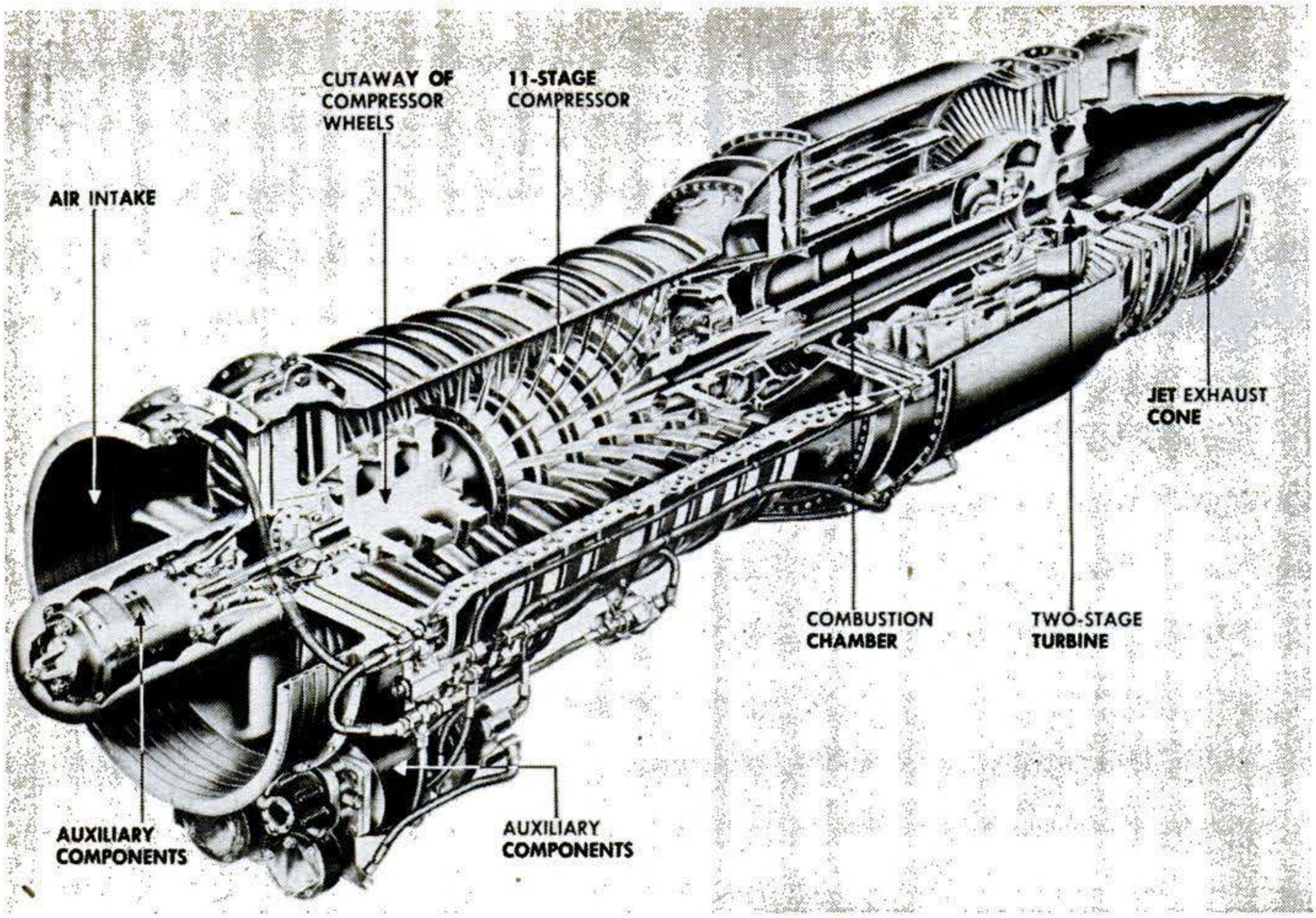
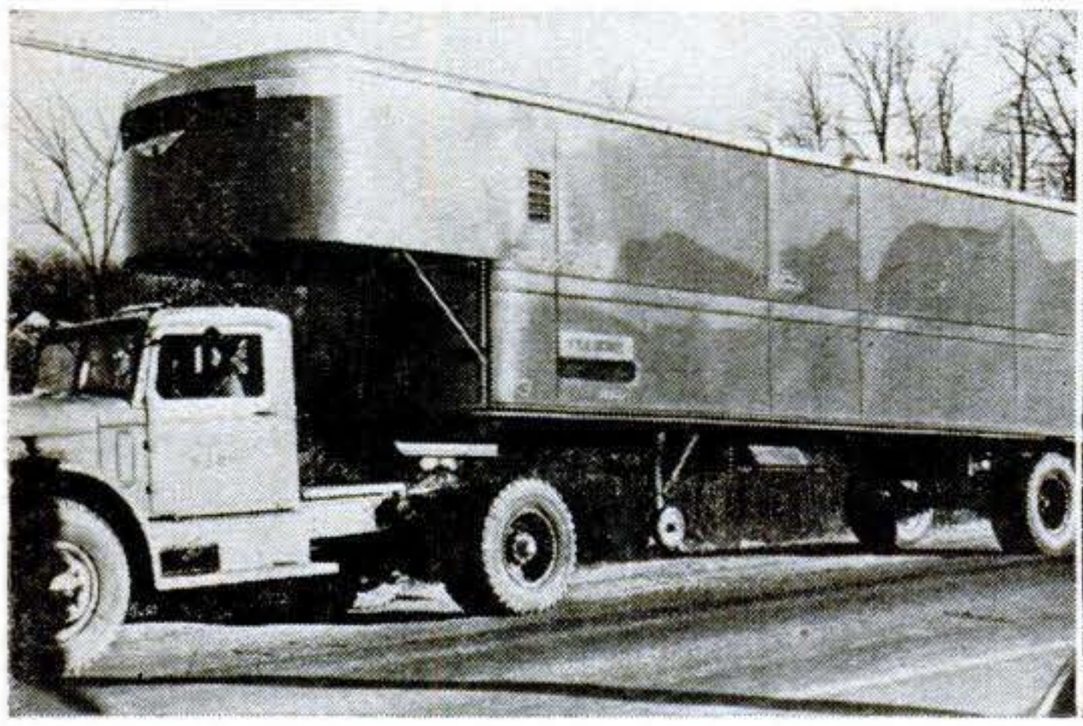
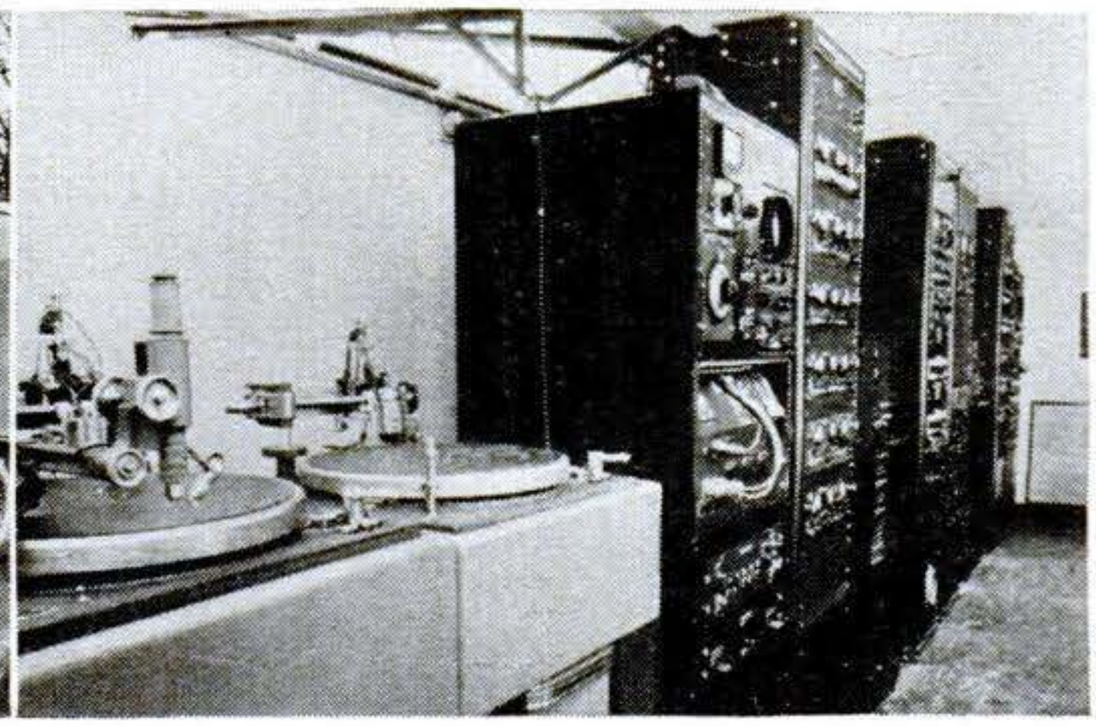


5,000-Hp. Jet Unveiled

THE veil of secrecy shrouding one of the hottest U. S. jet engines, the Westinghouse J-34, has been lowered enough to give you this inside peek. The 10-foot-long unit produces more than two and a half pounds of thrust for each of its 1,200 pounds of engine weight—equivalent to 5,000 hp. at high jet speeds. A pair of J-34s powers the Navy's McDonnell Banshee shipboard fighter and the Air Force's new Lockheed F-90 penetration fighter. Standing still, the engine sucks in air at 250 m.p.h. and spews it out of the nozzle at the rear at 1,200 m.p.h. The compressor blades whirl 12,500 times a minute to pack in the 100 tons of air the engine "breathes" an hour.





Missiles Get Mobile "Ears"

NAVY scientists won't miss any of the vitally important data being radioed down from sky-searching rockets. Their latest telemetering system has its receivers set up in a trailer that can be moved wherever reception is best. The trailer (left) contains two complete stations to handle the 60 messages at once sent from the research rockets. The picture at right shows the interior, including the telemeter receiver panels and two turntables for disk recording. Built by Johns Hopkins, the unit—which also includes heating and air-conditioning equipment—fills the specially adapted trailer.

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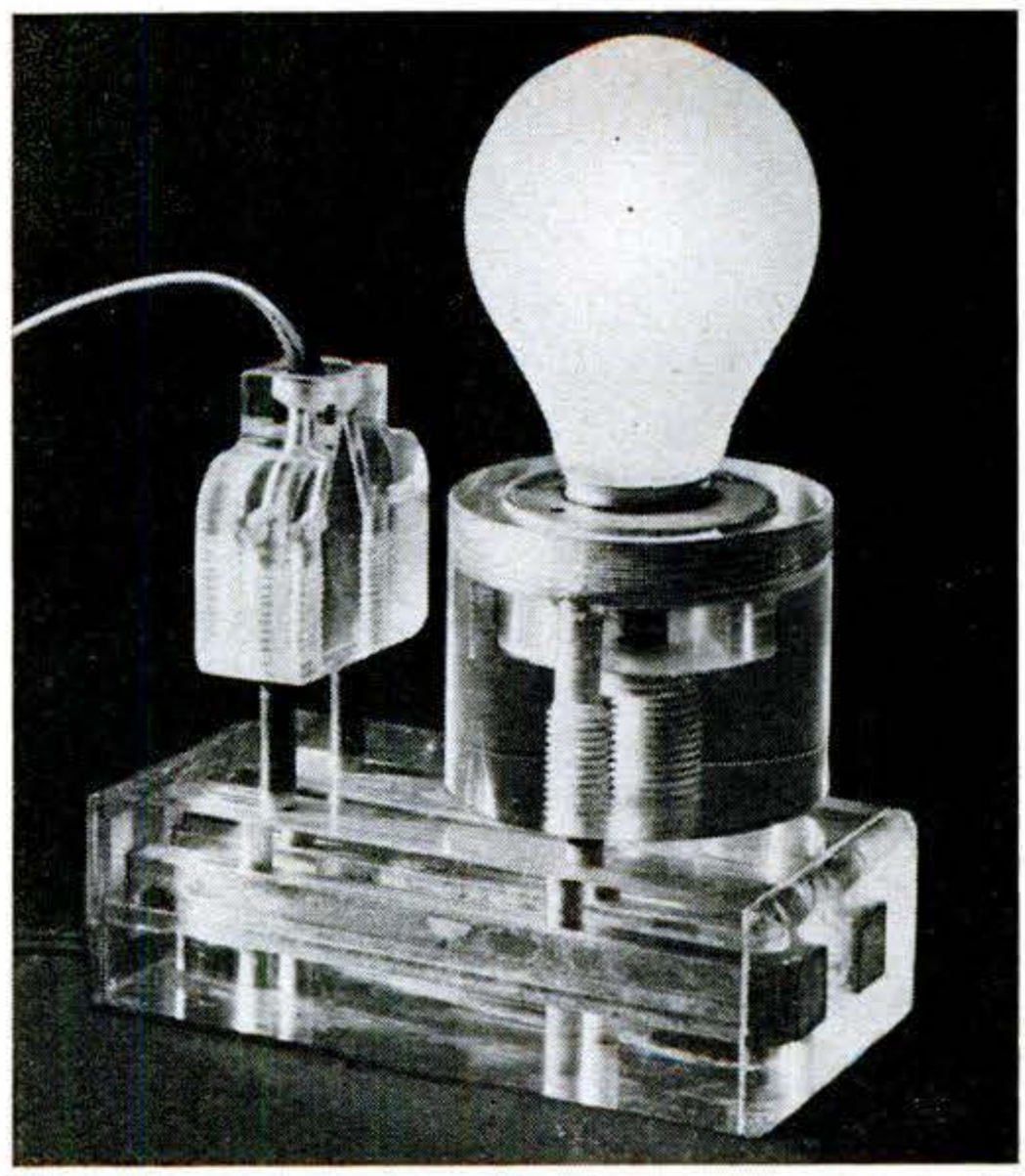
New Plastics Conduct Current

PLASTICS, widely used as electrical insulators, now offer promise of filling new jobs in the electric and electronic fields. A new class of plastic materials under development by Markite Company, New York City, and Naval Ordnance Laboratory, makes it possible to mold plastic forms exhibiting a wide range of conductivities.

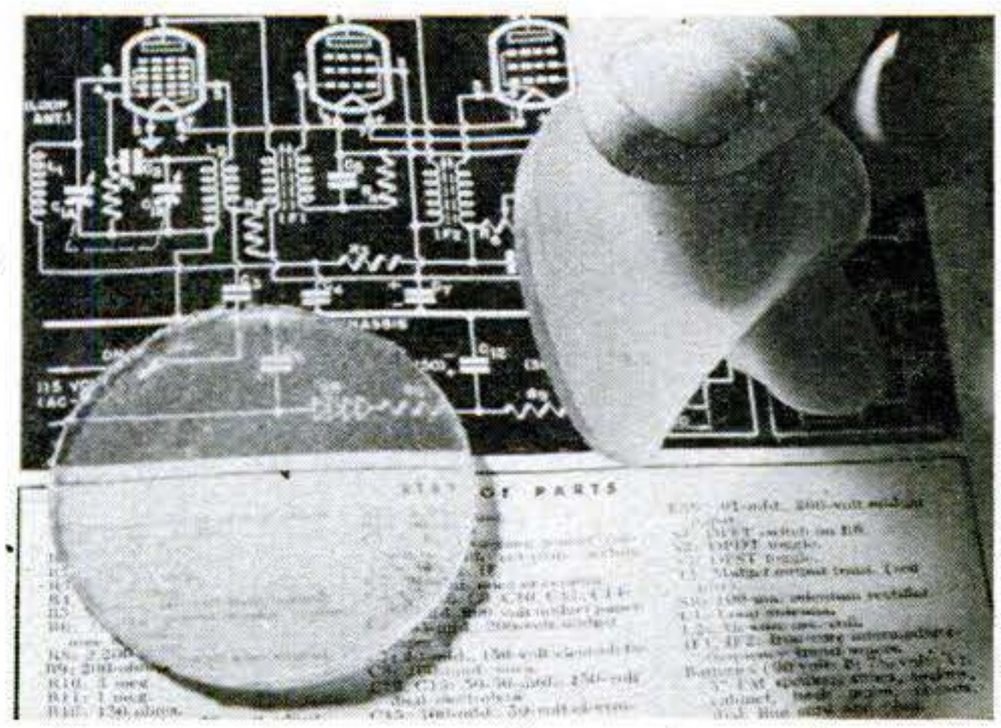
Like ordinary insulating plastics, these Markites® can easily be molded, machined, pressed, or formed into practically any shape. This is of special value in mass-producing intricate conducting parts, such as some three-dimensional circuit elements.

An important feature of the Markites is that they possess the general mechanical properties of ordinary insulating plastics. Because they expand and contract with heat at about the same rate as certain insulators, they can be molded together with the insulating materials in fluid-tight structures. Since the expansion rates are the same, there is little danger of the "co-molded" segments coming apart under the stress of friction, heat, or cold. Markites have been made with unit resistances as low as that of mercury.

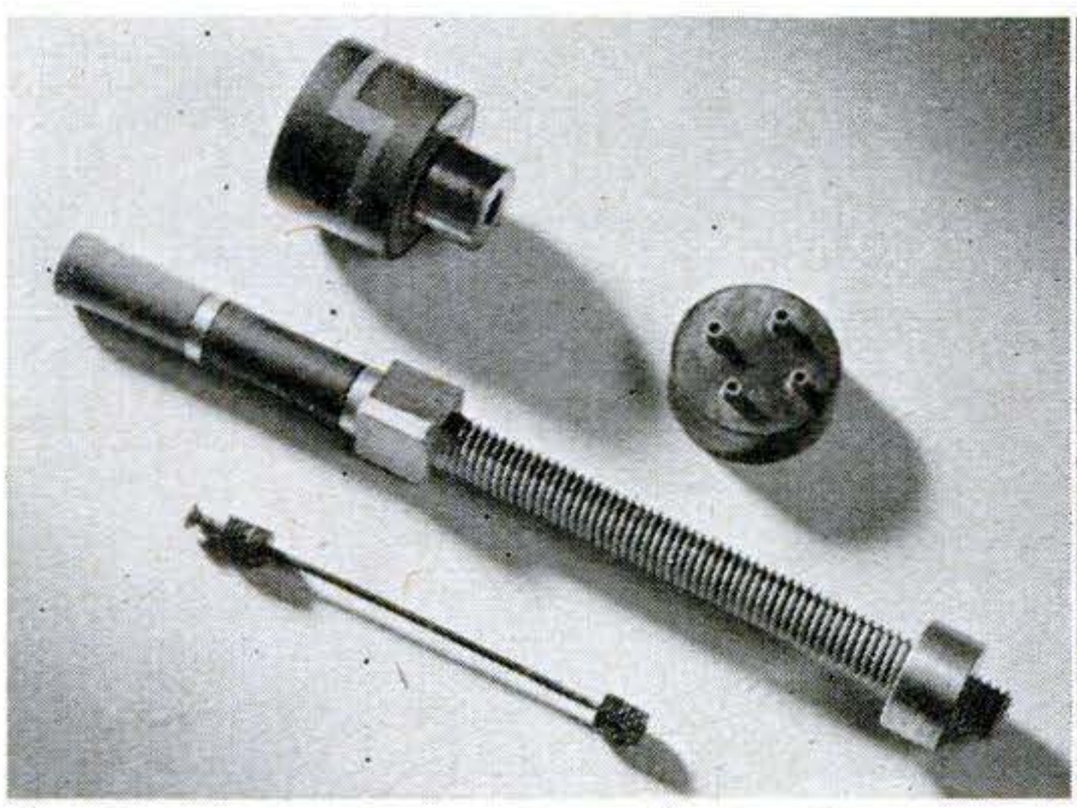
But don't expect to buy lamp cords that are plastic through and through—Markites cost too much, are still limited to special applications warranting the expense.



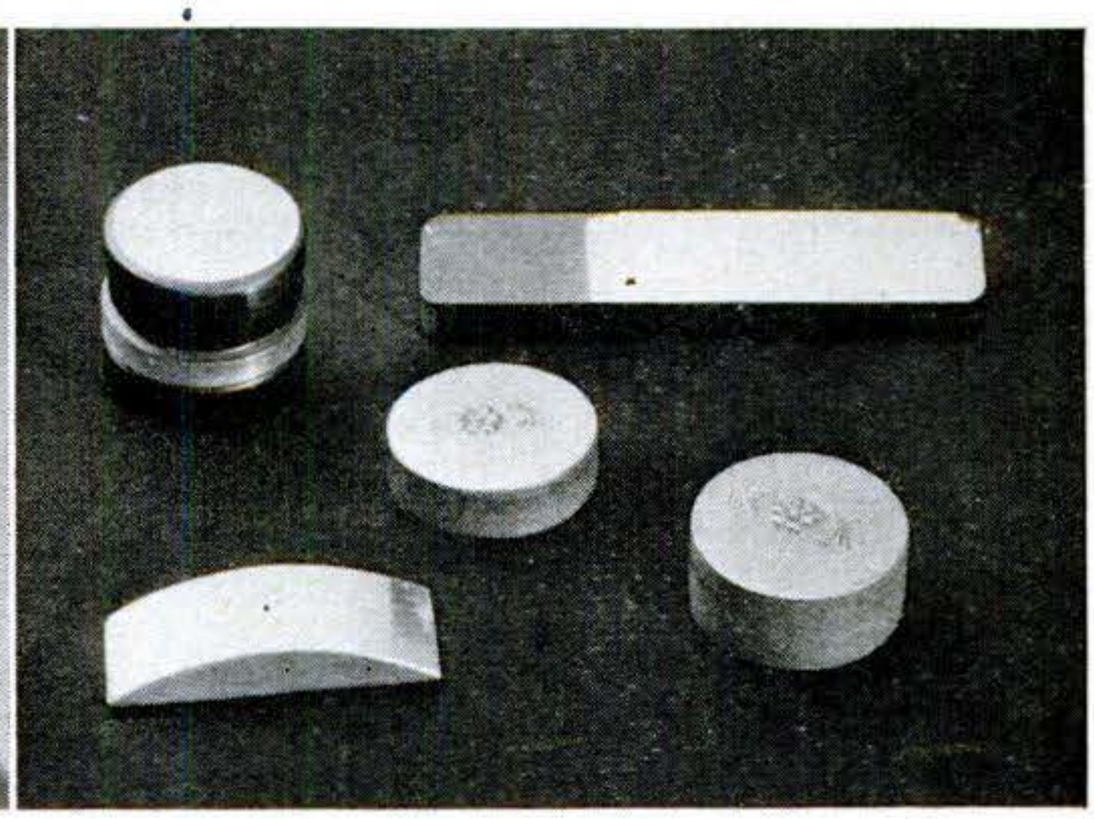
There's no metal in this lamp except in bulb and cord. Internal connections are all Markite®.



Conducting plastics can be made nearly transparent, and flexible enough to be bent double.



Conductor and insulator—both plastic—can now be molded together. All-plastic commutator (upper left) has integral conducting segments instead of metal inserts. It can't come apart under friction heat. Other pieces include threaded resistor, thin rod, part for "bridge."



Electroplating, important in many electrical applications, is much easier with conducting plastics. Unlike ordinary plastics, which must be coated with metal before plating, Markite samples above were plated directly. The bond between plating and plastic is also stronger.

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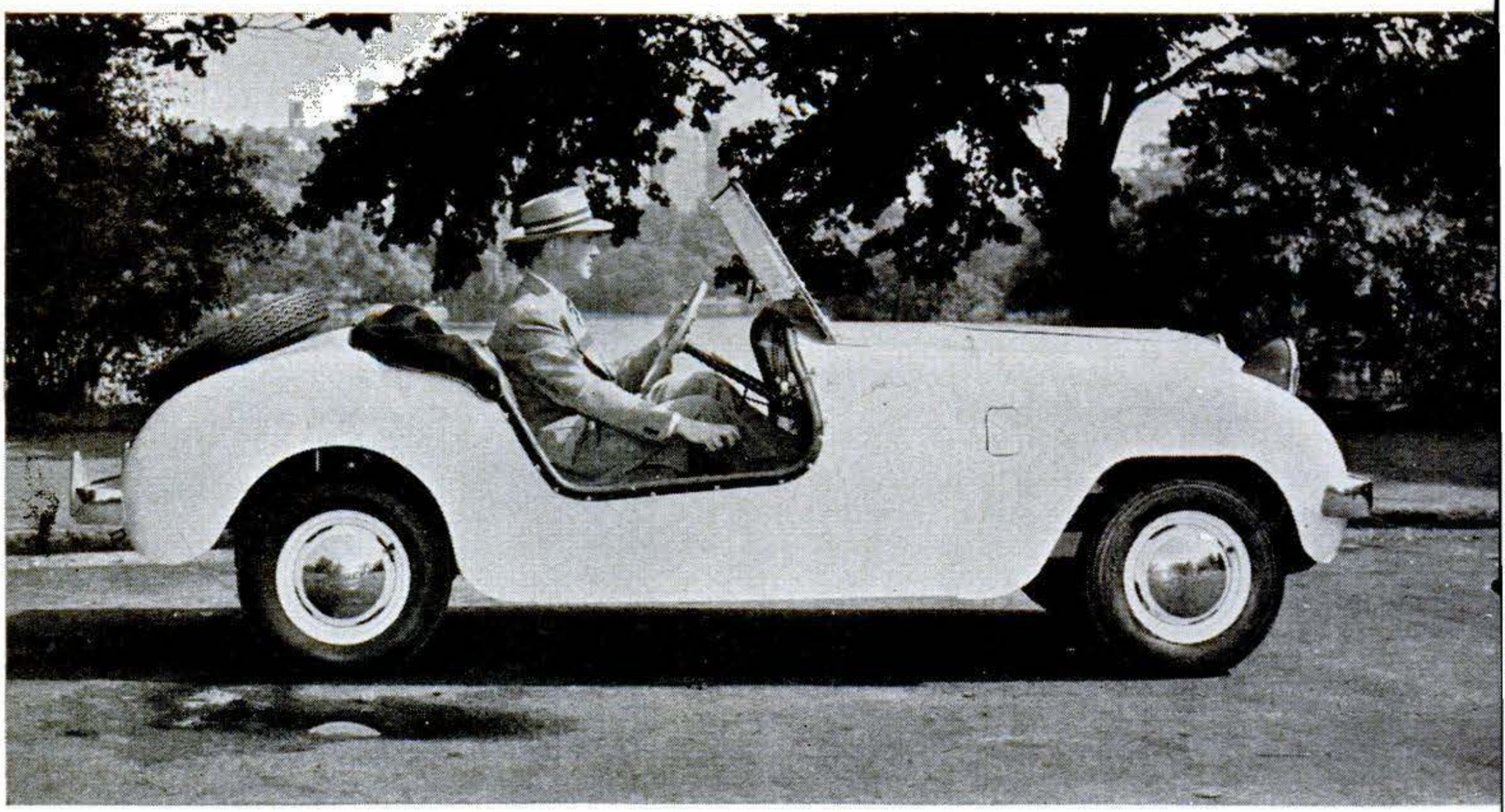


New Crosley Roadster

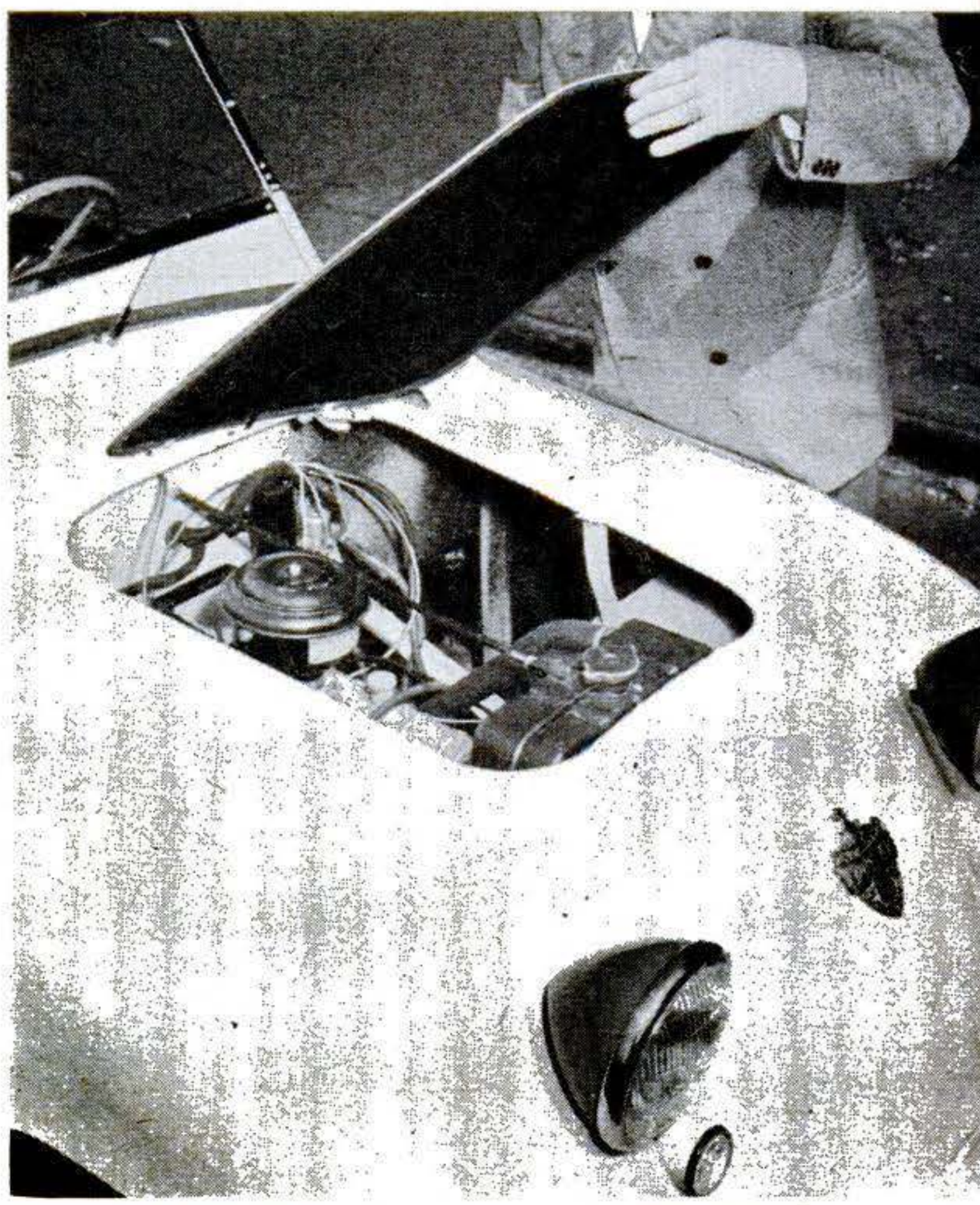
CROSLEY'S new, underslung roadster is designed to lead a double life. Strip off the windshield, headlamps, bumpers, top, and spare wheel—and you've got a racer.

Christened the Hotshot® and priced at less than $1,000, the roadster-racer represents Crosley's answer to the small sports cars coming from Europe.

Brightly painted and sporty in appearance, it breaks with Crosley tradition in several ways. A new frame, sweeping down at the middle and up at both ends, puts the driver and passenger close to the ground and gives the car a long, low silhouette. The wheelbase is 85 inches, five inches longer than other Crosley models. The over-all length is 137 inches, the width 51.

At its rear wheels, the Hotshot introduces a novel method of suspension. Coil springs bear most of the load, but working in conjunction with each coil is one leaf of the quarter-elliptic springs that previously did the entire job. Semi-elliptics are retained at the front. New larger hydraulic shock absorbers are used at all wheels.

Crosley's recently developed 26.5-hp. Ciba® engine powers the Hotshot. This engine has a cast-iron block instead of the brazed assembly of the old Cobra®.



Removable panel gives access to engine. Hood sweeps gradually down to the bumper line. In place of a grille, the car has an air scoop, under the bumper, to feed air through radiator.

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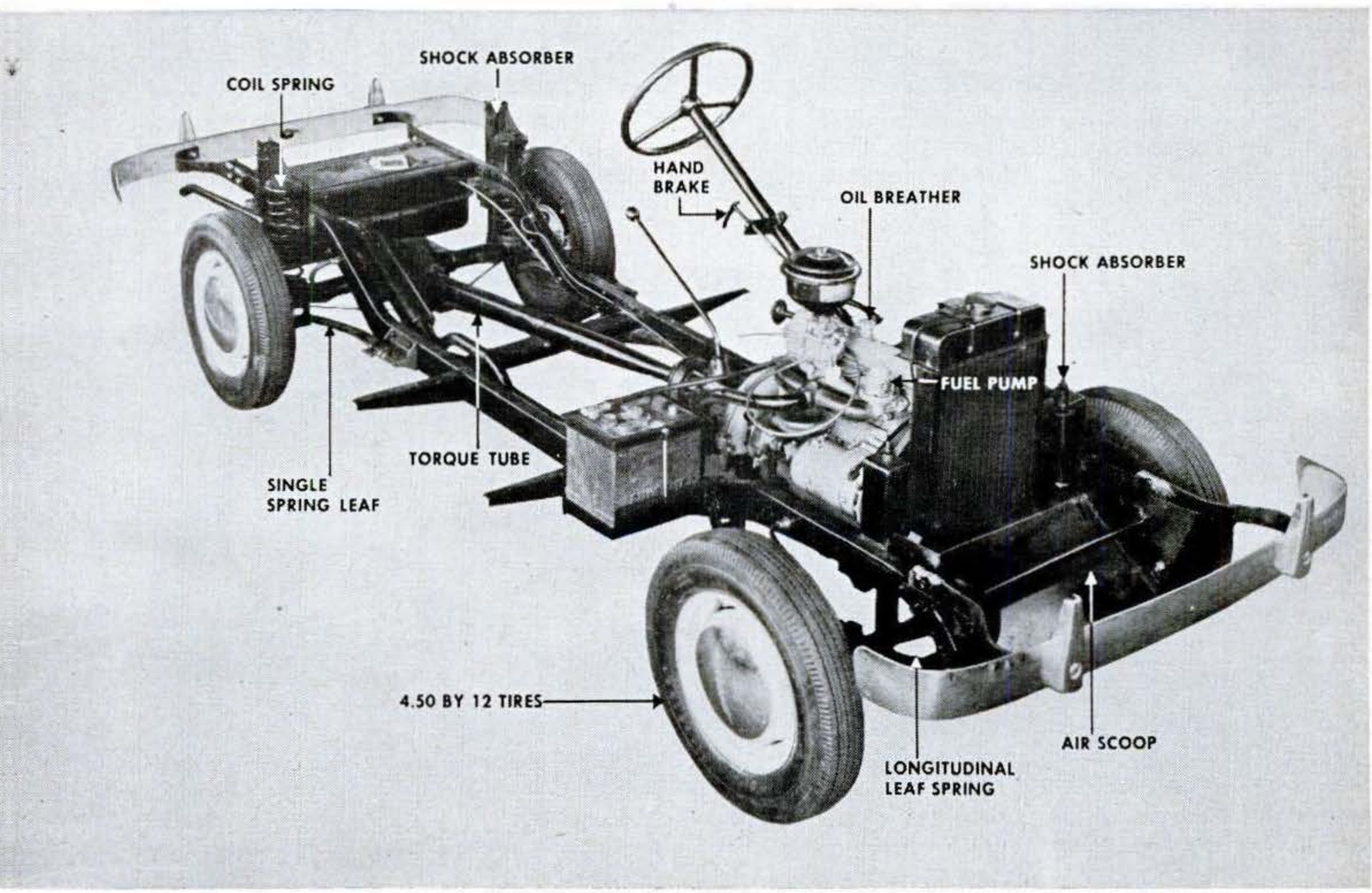
Strips Down to Racer



Cradle frame gives a road-hugging silhouette and a lower center of gravity. Rear suspension is unconventional—a coil combined with one leaf of quarter-elliptic spring. Besides bearing a fraction of the load, this leaf also functions as a torque rod. Strut-type shocks provide damping at all wheels. The engine has been moved behind the sleek car's front axle.

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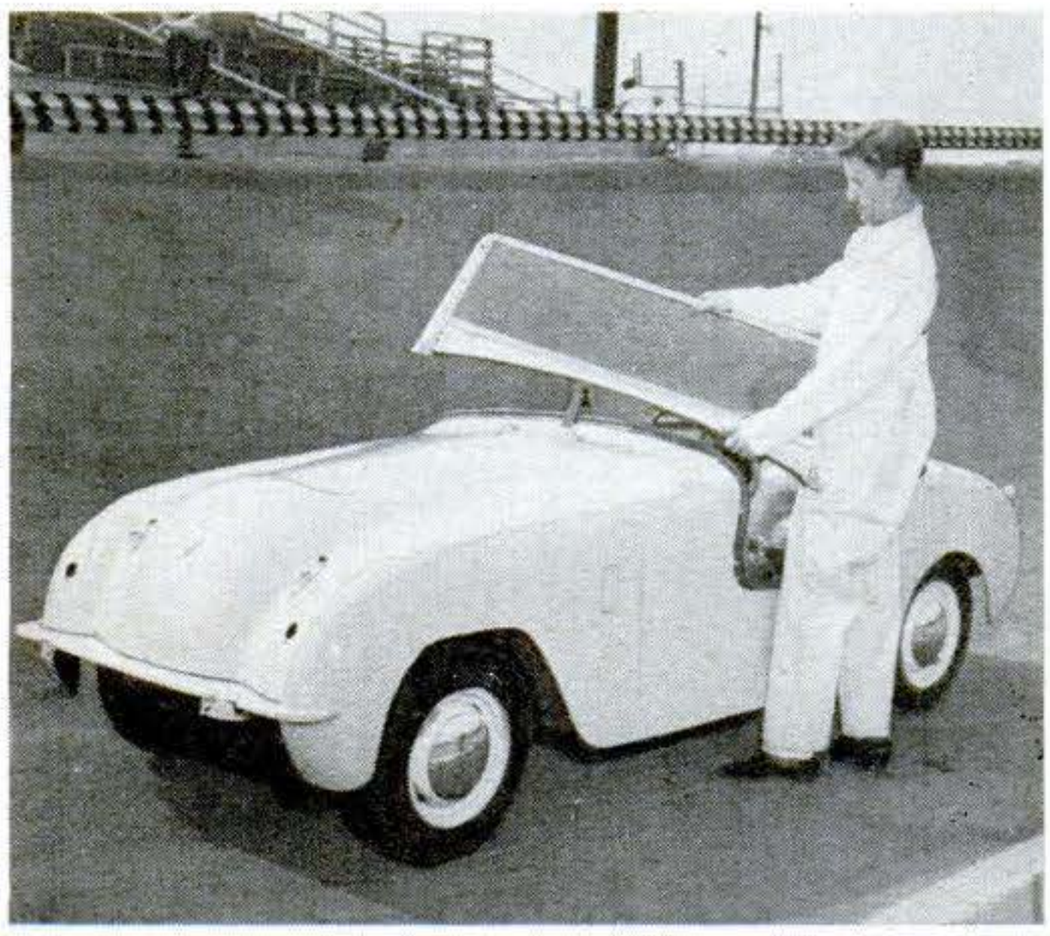
Shallow doors hook on, a fabric top pulls into place (see lower right), and curtains enclose cockpit when need arises. Rubber molding on edges of cockpit gives you protection against bumps. The leather-covered seats pivot forward for access to luggage area behind. Like other recent Crosley models, roadster is fitted with hydraulic disk brakes (PS, Aug. '49, p. 169).



Stripped for racing, the roadster scales about 104 lb. less than its usual 1,095. Stripping can be done in a few minutes. To make the job easier, wires to lights are fitted with plugs and mating sockets. Powered by Crosley's high-compression, overhead-camshaft engine, the Hotshot® is said to promise good racing performance. It has done upward of 80 m.p.h.

You sit low, only 16 inches above the pavement level, but there's comfortable leg room inside for a six-footer. In over-all length and width, the roadster is about the same as conventional Crosley models, but its wheelbase (85 inches) is five inches longer. The road clearance is eight inches. A removable steel frame supports the top. Battens strengthen the curtains.

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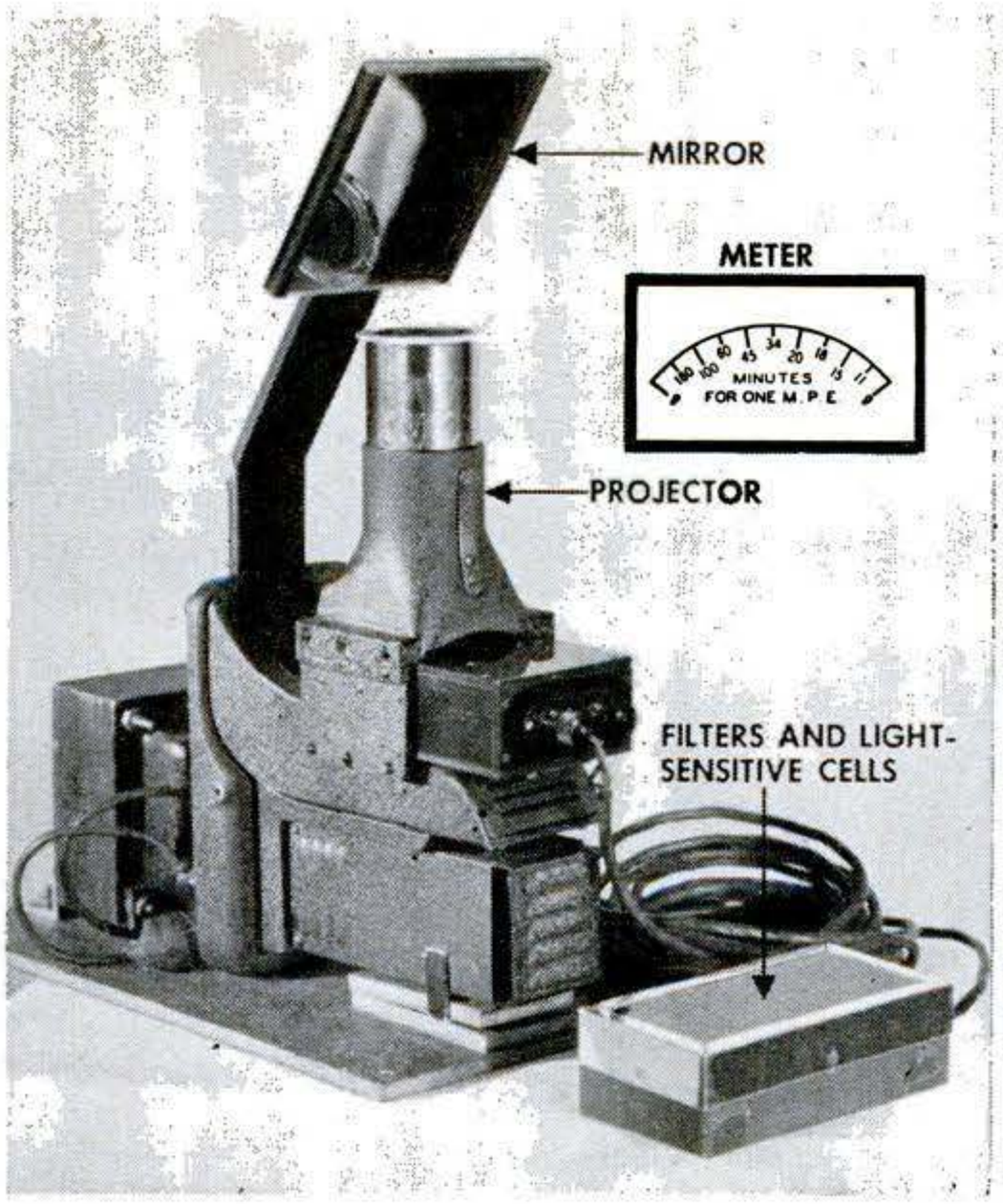
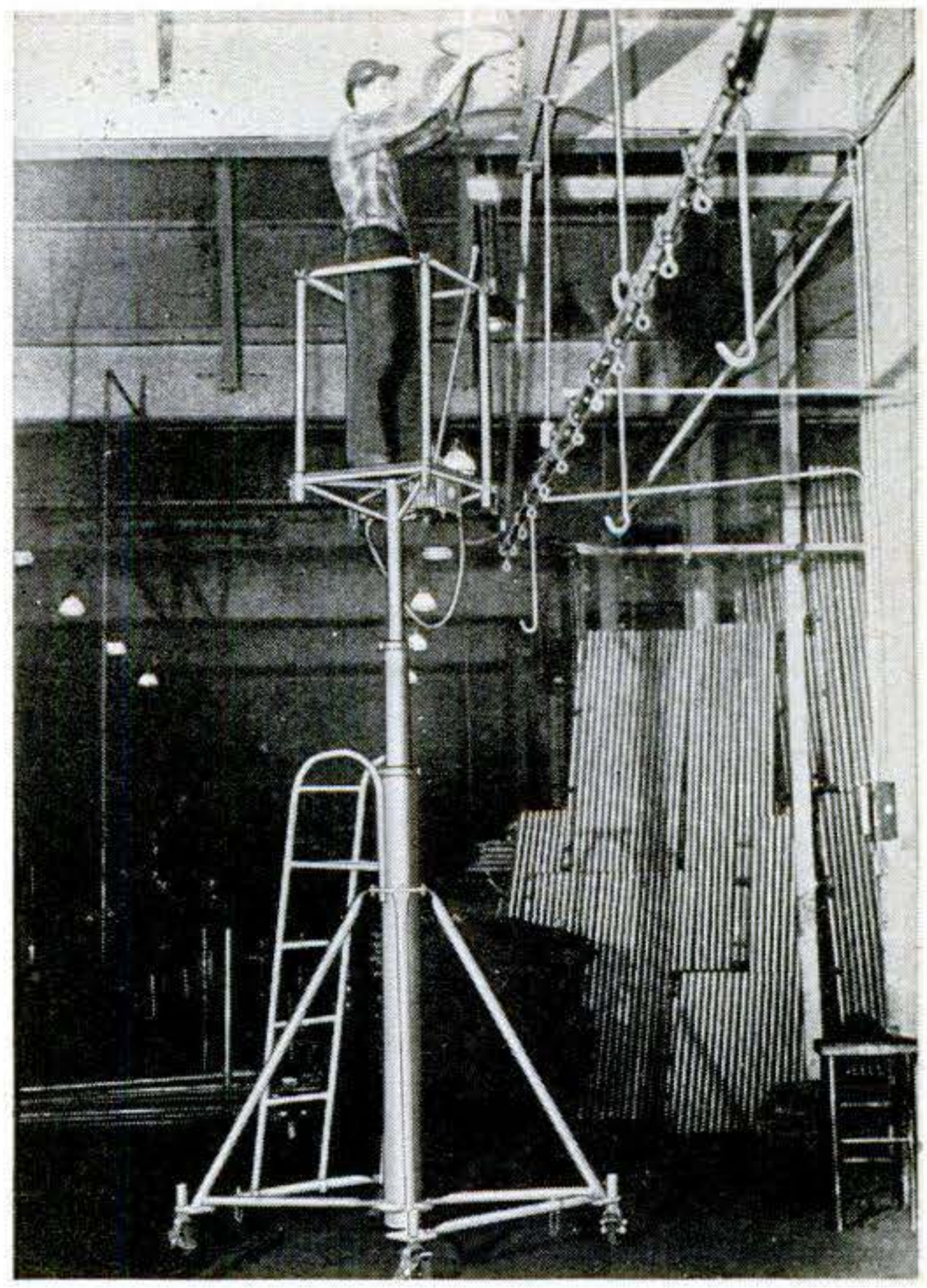


"Tan" Meter Times Sunbaths

You can sun-broil yourself to just the right shade tan with a sun-tan meter developed by Hoyt S. Scott, GE engineer.

The model above, for big indoor solaria, projects on a screen the image of a dial (inset) that tells how long you must sunbathe for one "minimum perceptible erythema" – a faint pink sunburn. It uses photocells, like those in photographic exposure meters, plus a complex set of filters and a fluorescent screen to limit measurements to the "colors" causing tanning.



Tower Lifts Worker to Ceiling

A PORTABLE elevator raises workmen high enough to clean light fixtures on a 23-foot ceiling, yet telescopes down low enough to pass through a narrow, seven-foot door. The Hydro-Lift®, made by Safway Steel Products, Milwaukee, is raised by a hydraulic pump operated manually from the platform. A toggle releases pressure for lowering.

Hearing Aid Sticks to Head

ADHESIVE like that on cellulose tape holds this Acousticon® hearing aid in place. Eliminating the pressure headband formerly used, the new device is less conspicuous and more comfortable to wear. The small button transmits sound by conduction through the skin and bones of the skull.

Rays Dry Hands, Kill Germs

You still have to wash your hands yourself, but they may be dried automatically when placed under the Electronic Towel®. A photoelectric cell starts off infrared units to heat the hands, a powerful hot-air blower, an ultraviolet-ray lamp to kill germs—and a counter to record the towel's use.

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Building a drop-test model for recorded flight is no job for home-workshoppers. In foreground is the disassembled skeleton of metal parts, including dural main assembly and lead weights. After assembly, skeleton is covered with plastic skin. Finished model weighs half ton.

The real XF-90. It is powered by two J-34 axial-flow jet engines.

Sonic Models Predict Tricks of Latest Jet

By Andrew R. Boone

WHEN Tony LeVier, Lockheed's chief test pilot, whipped the XF-90 through its first flight recently, he wasn't much surprised by its tricks. Six miniature replicas of the Air Force's new needle-nosed jet had already told him what to expect.

No balsa-and-glue toy, each of these models was precision-made of steel and plastic, weighed about half a ton, cost $15,000—and smashed into junk after its one and only flight. Yet the money and effort were well spent, for the model fighters carried equipment that telemetered reports on stability and aerodynamic characteristics to the ground as they screamed earthward faster than sound from the belly of an F-38 seven miles above Muroc Base, Calif.

The model drops were only part of the comprehensive testing that today's high-performance planes go through before their first flight. Some $600,000 was spent on wind-tunnel-testing the XF-90, not including the extensive spin-tunnel sessions.

The models depended on gravity and streamlining to fall at supersonic speeds. Strain gauges told Lockheed engineers exactly what forces were exerted on the swept-back tail group, and other recordings indicated response to the controls.

$15,000 models that fly only once are cheap insurance—the XF-90 now undergoing flight trials cost several million.

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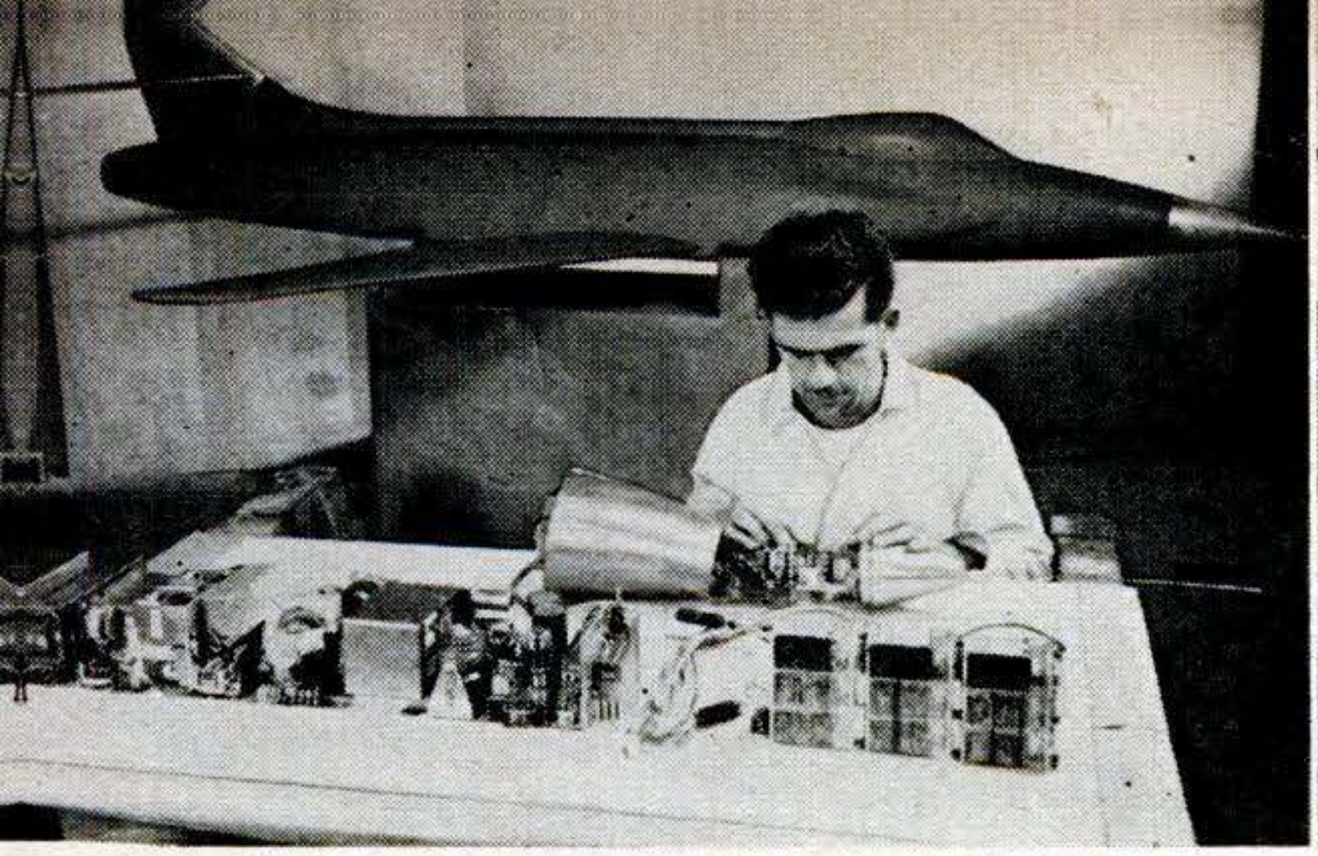
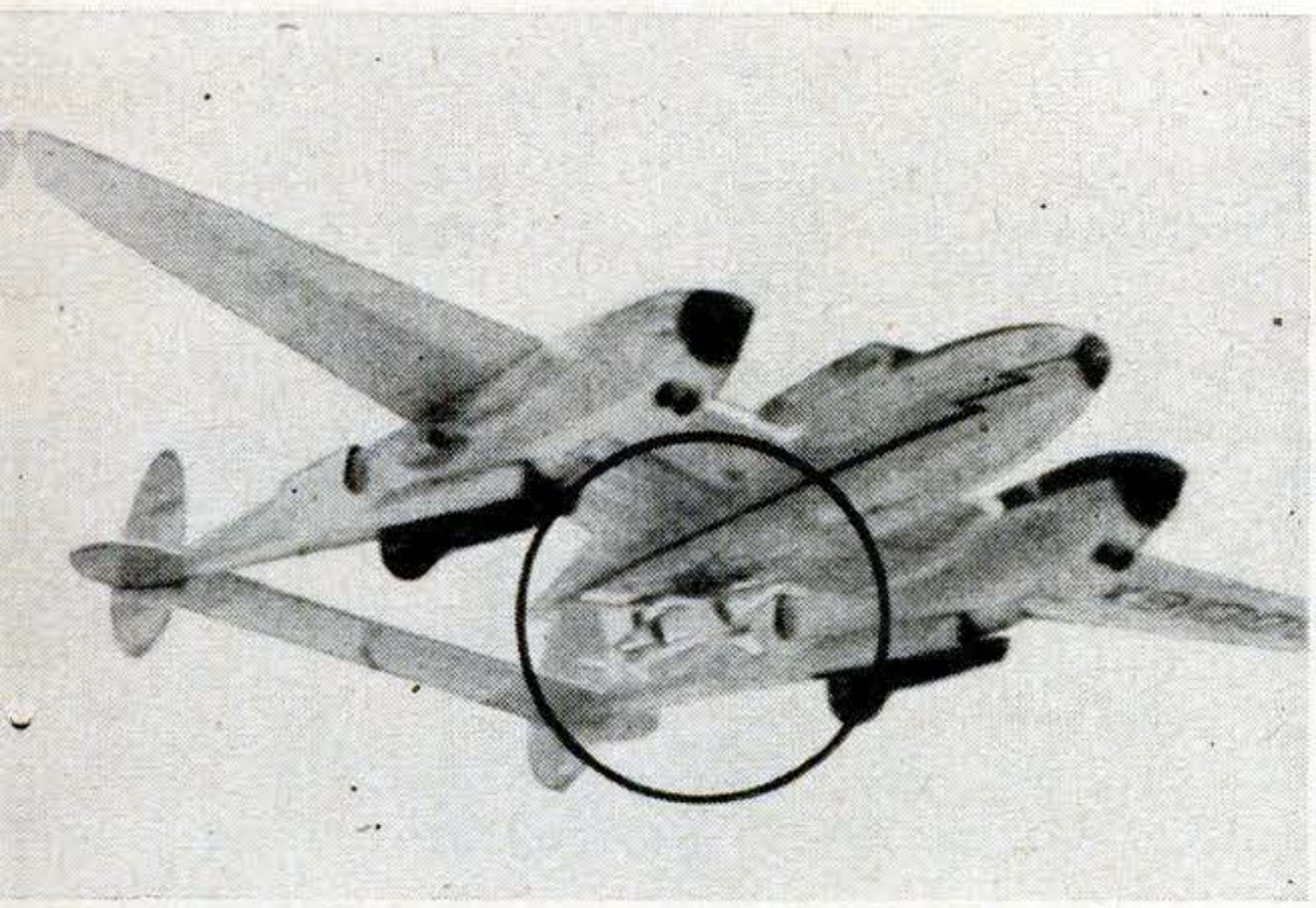
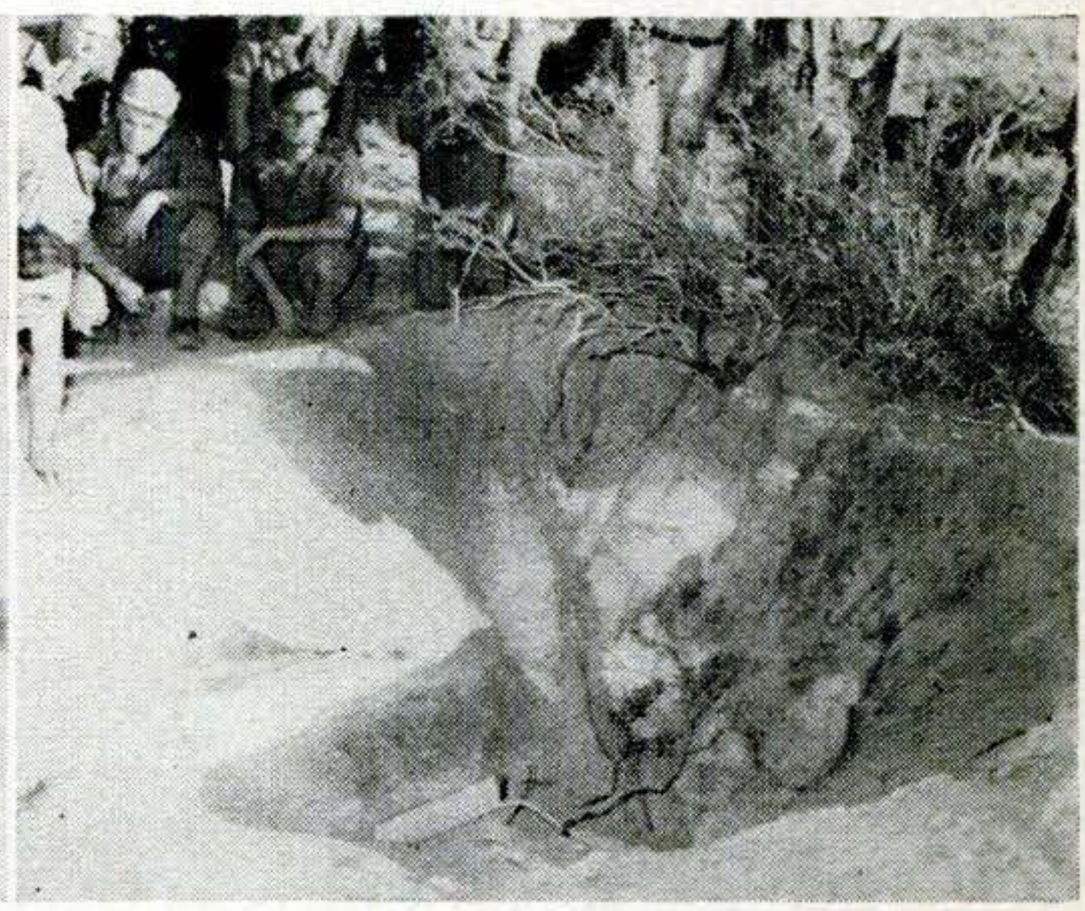


Technician is assembling the autopilot that goes into the nose of the model. In the foreground are various units of the eight telemetering channels that transmit performance.

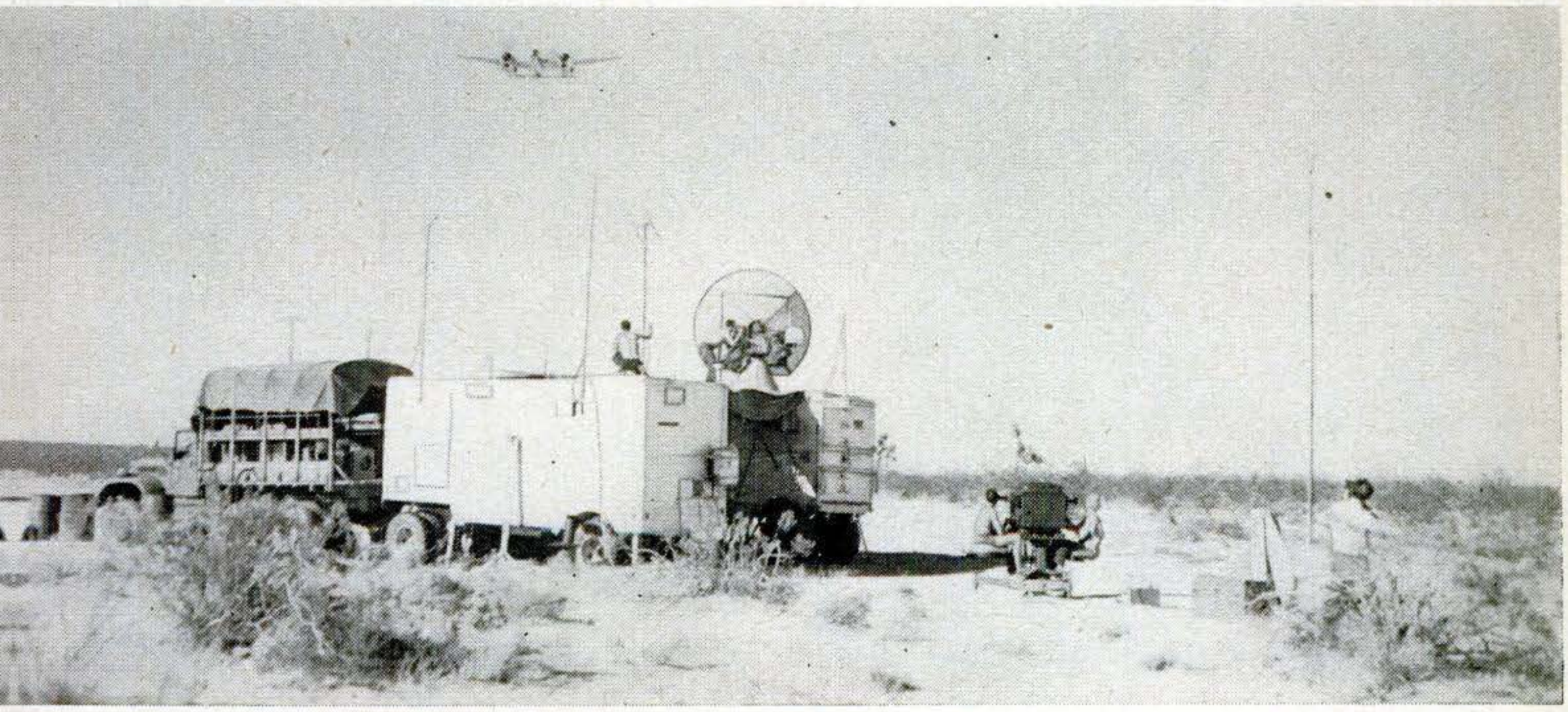
Here the 910-lb., plastic-skin model is being attached underneath the fuselage of an F-38. Model rides upside down until it is released. Special bomb shackle holds it firmly in place.



Snuggled against the belly of an F-38 wartime fighter, the XF-90 model waits drop signal. It is released at 35,000 feet, and falls in a path set by a combination time-pressure switch.



Plowing into the desert floor at a speed over 750 miles an hour, the model digs quite a hole, as shown here. The crater is searched, although parts have little value except as souvenirs.



Before each drop, the F-38 flies low over the ground station to test range-measuring radar, radio and telemetering equipment, and high-speed cameras. In center is the telemetering ground station. Man behind the radar disk on top of trailer is operating a movie camera.

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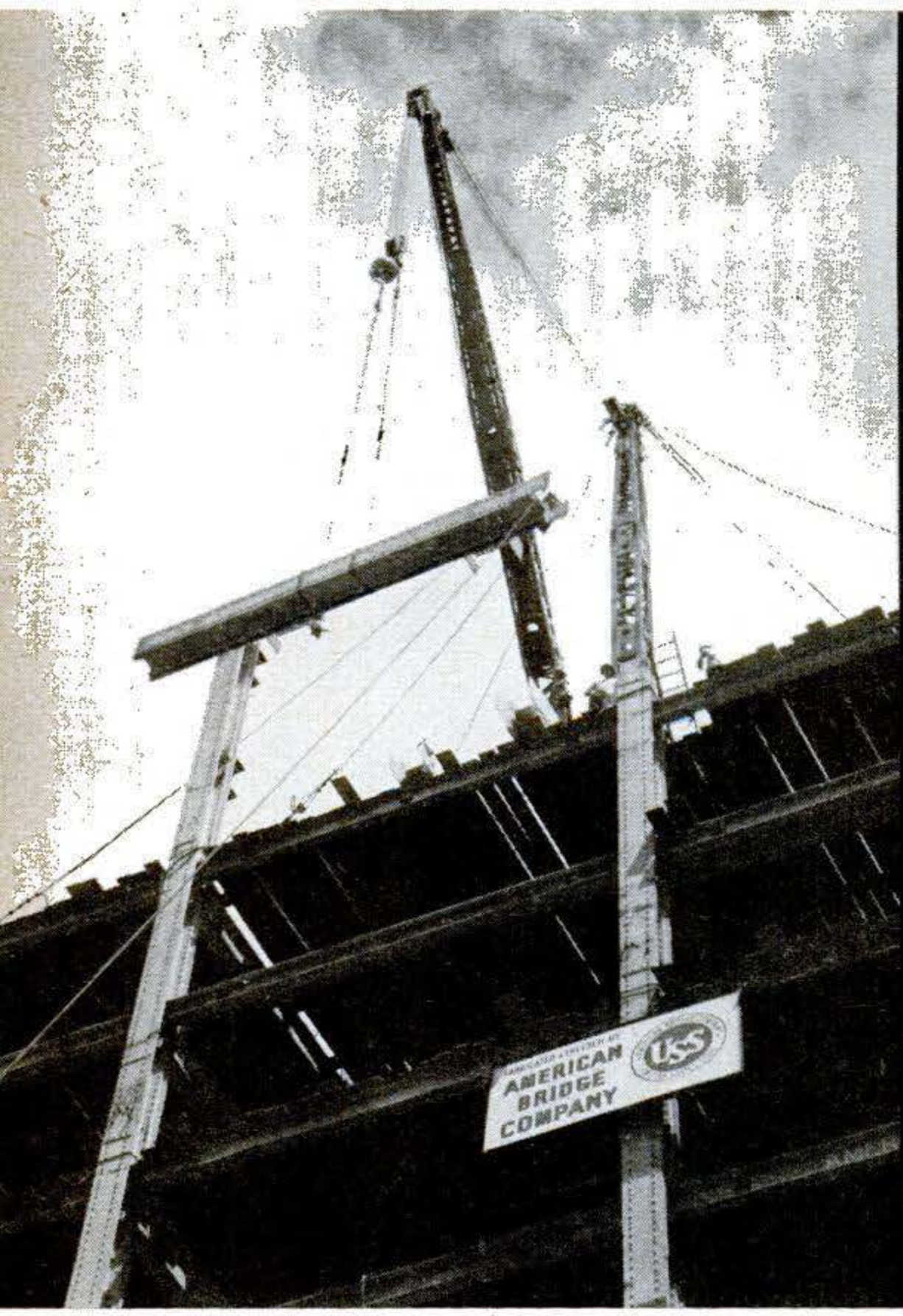
Model of future United Nations headquarters (left) shows tall, slender Secretariat Building as it will appear when completed next year.

How They Put Up a New Skyscraper

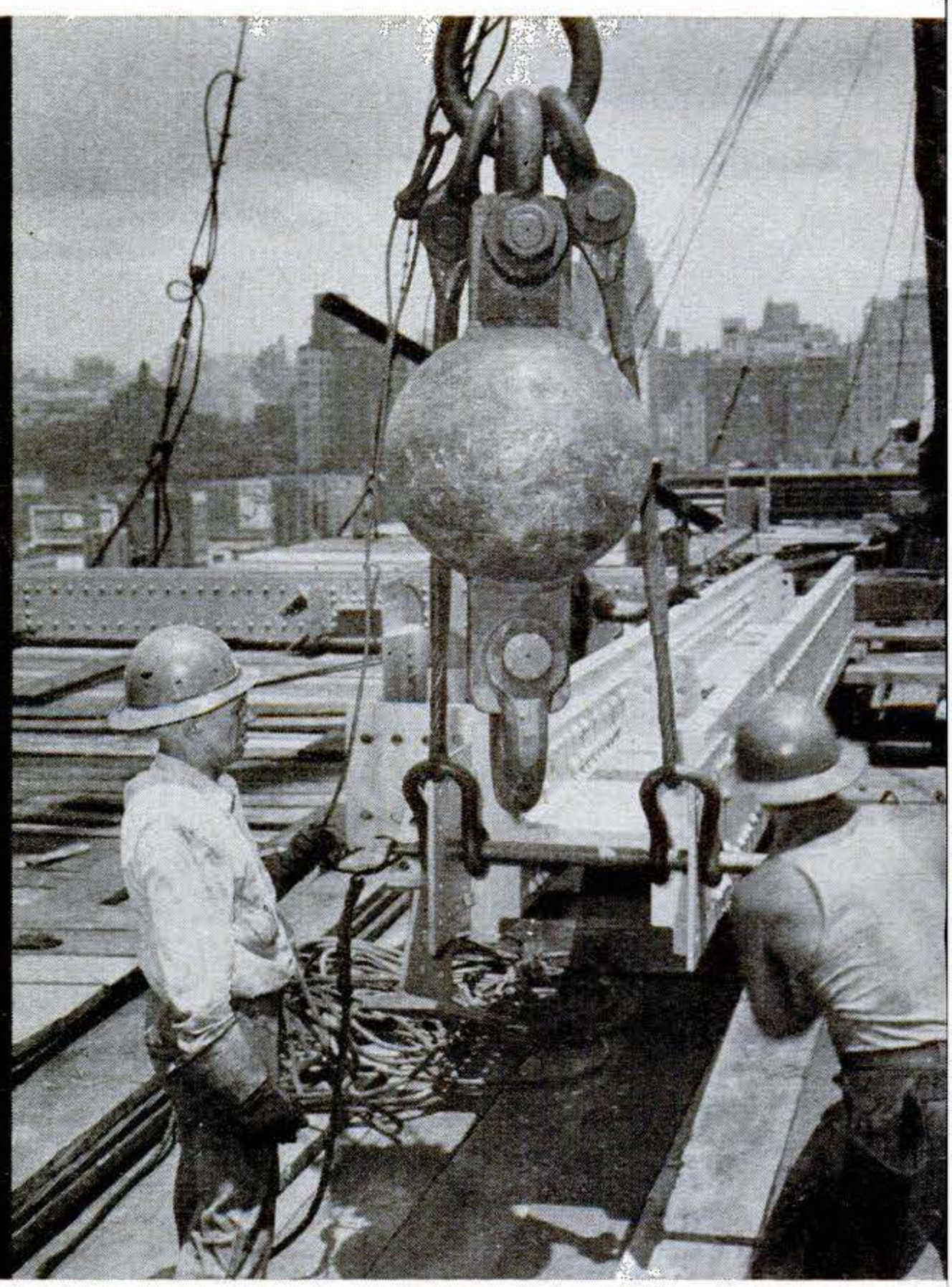
PS photos by W. W. Morris

WHIRRING like cicadas on a hot summer's day, with amplified metallic voices, riveting hammers are assembling more than 13,000 tons of steel for the framework of the United Nations' 42-story Secretariat Building in New York City.

Familiar to steel men but ever new to spectators, the drama of flinging a tower at the sky is caught by the camera of a POPULAR SCIENCE photographer on these pages. Four of New York's leading construction companies, under the combined name of Fuller-Turner-Walsh-Slattery, Inc., have joined forces to build the future world capital.



1 Spectator on ground sees girder hoisted by crane from delivery truck to top of framework. Camera's eye takes you aloft, in succeeding pictures, to follow steel men's work.



2 Briefly laid down at the top, girder now is picked up again by crane to be set in place. This one is a vertical member, for one of the outside columns of the building's framework.

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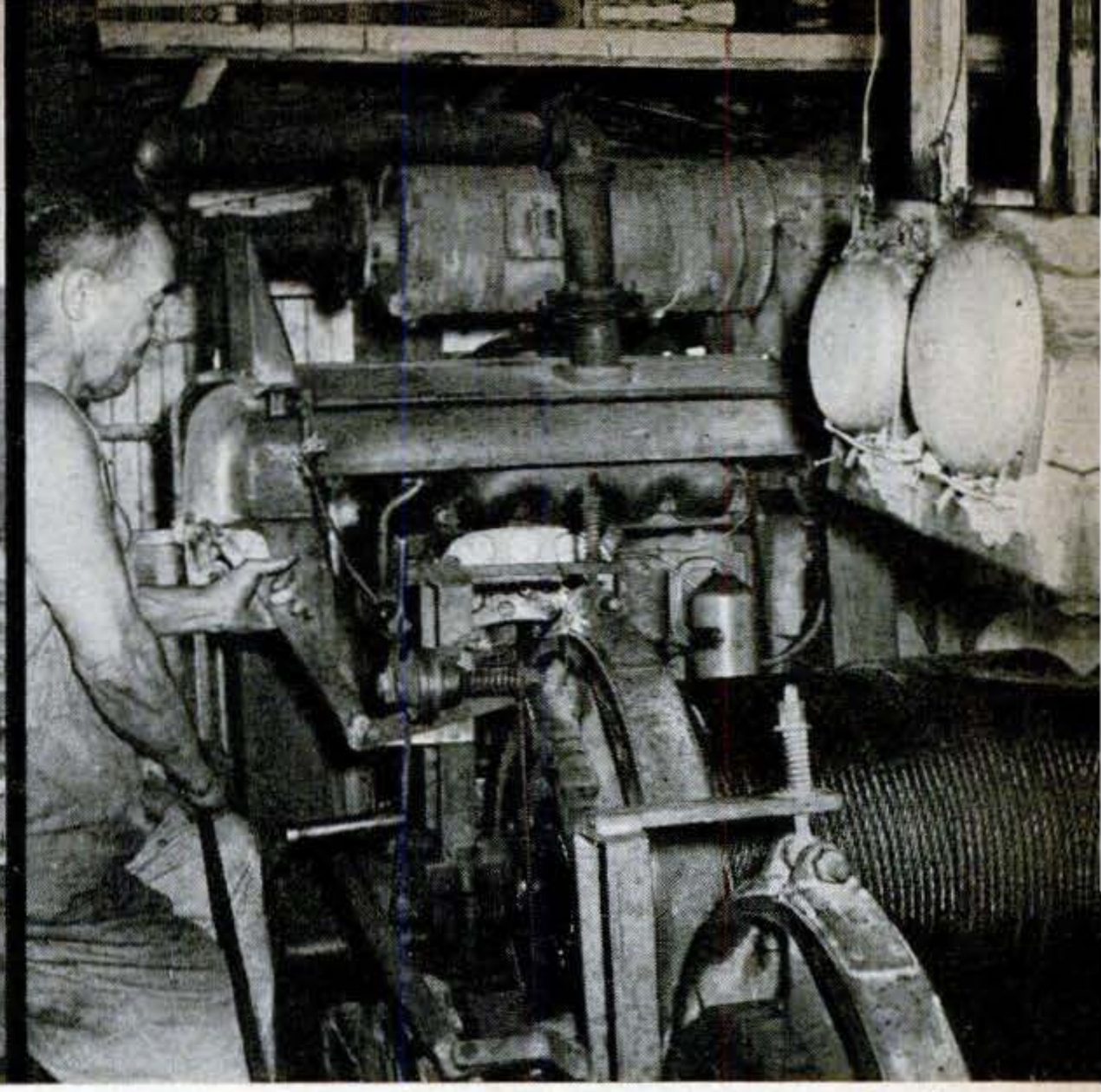
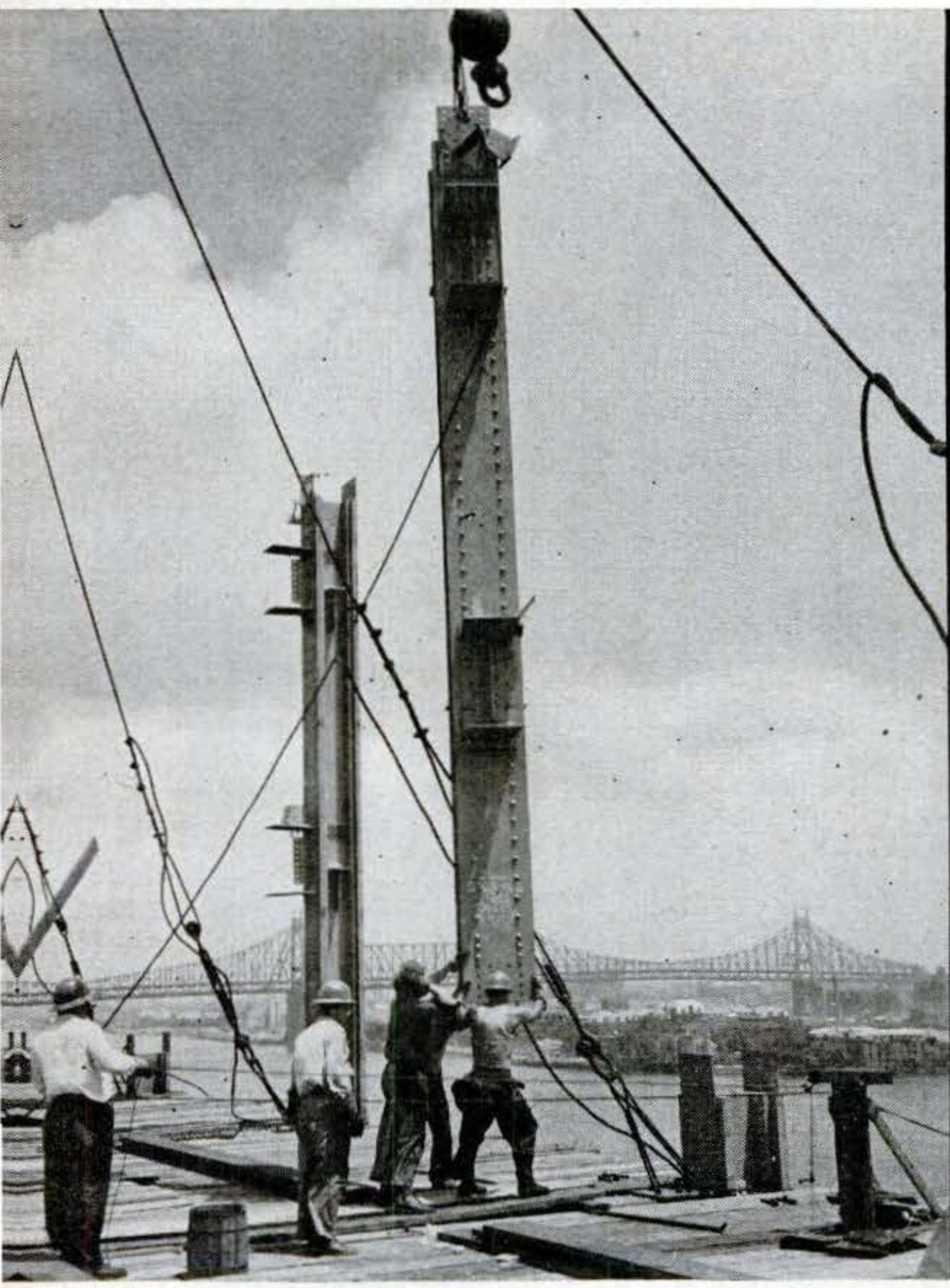
"Bellman," atop rising structure, directs crane bringing up a girder. He gives signals to crane engineer, operating winches at bottom of building, by pulling two cords that sound gongs.



Crane engineer, facing gongs, operates load and boom winches. Large gong is for load, small one for boom. Signals: one stroke to raise, one to stop; two to lower, one to stop.



3 **Maneuvering** the heavy girder takes perfect teamwork. Men steady dangling load as bellman, left, guides crane with cords running over pulleys at right and down to signal gongs.

4 **New section of column** comes to rest in exact alignment with one below it. Bolts will hold it in place temporarily. Later, joint will be made permanent by riveters.

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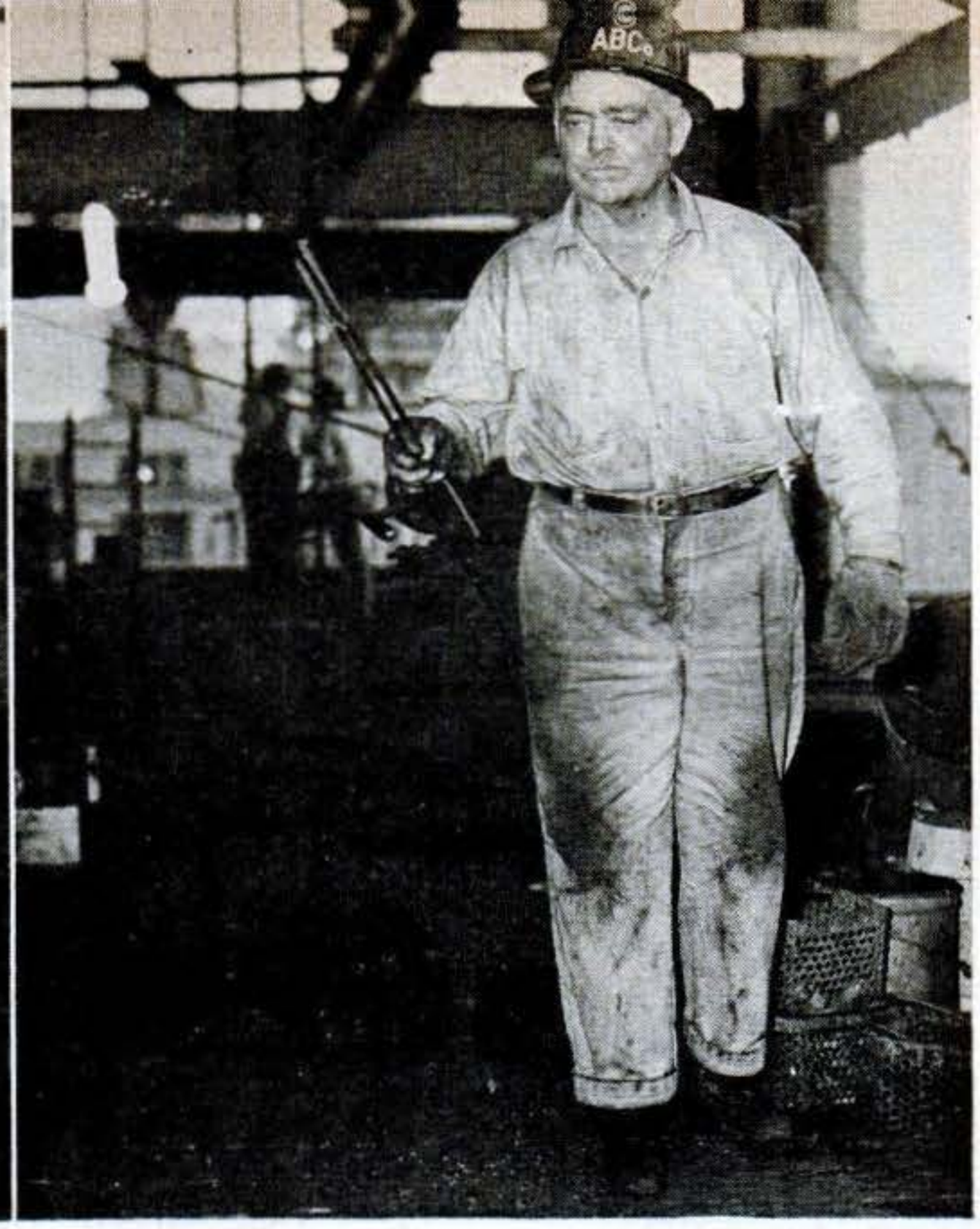
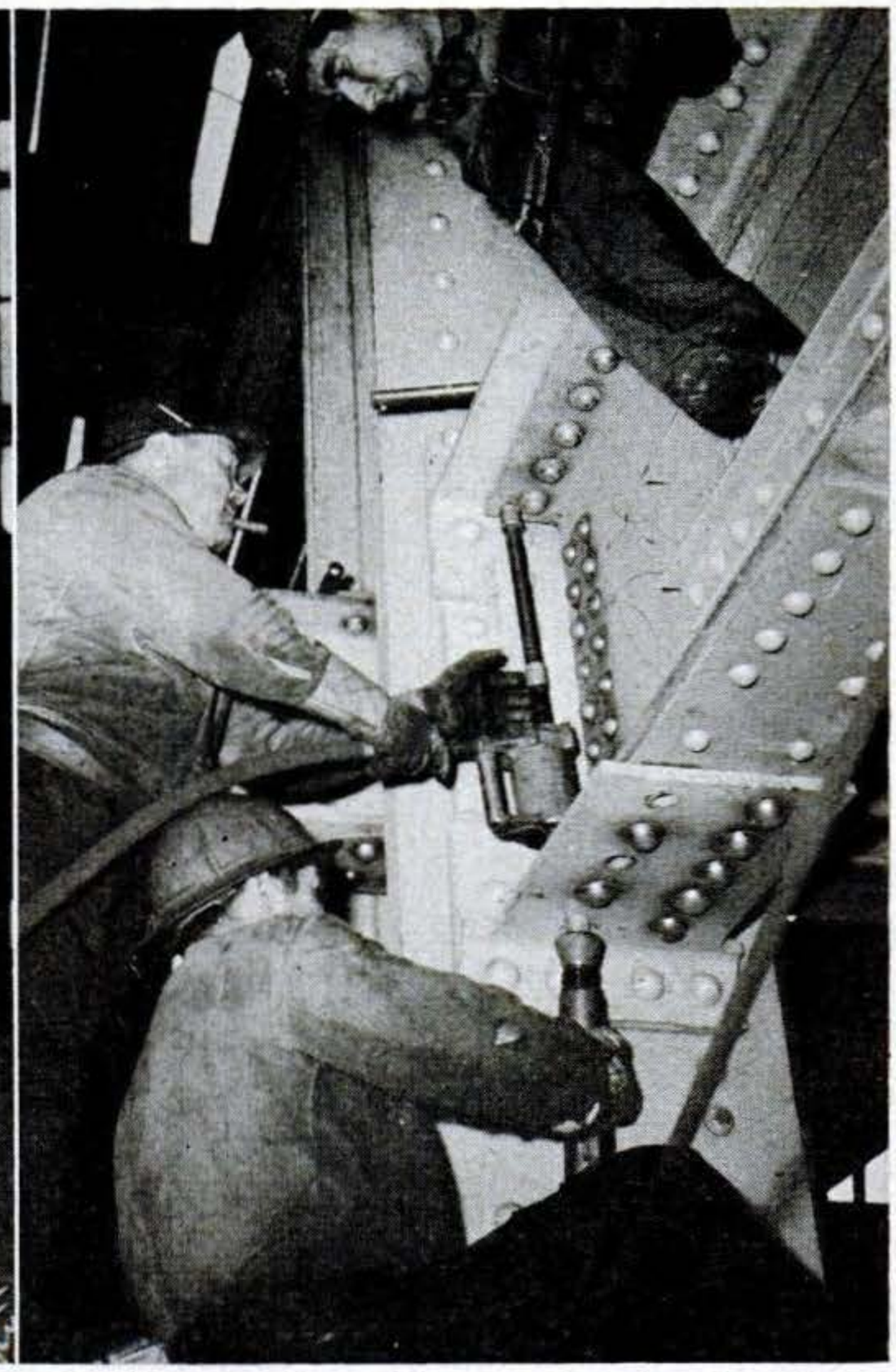
5 **Time-honored procedure** of riveters makes fascinating spectacle to watch. Perched on high platform, this worker heats rivets white-hot in stove fanned with air by hand crank.



6 **Catch!** Seizing incandescent rivet with tongs, man at stove deftly pitches it to riveting crew. Flying rivet, caught in mid-air by camera, is white streak just to left of tongs.

7 **Amazingly adept,** catcher, balancing on beam, almost never misses. Plunk! goes rivet, still seen in air, into his funnel-shaped bucket. Tongs in his hand transfer it to rivet hole.



8 **Pneumatic tool** braces rivet head while air hammer, below, forms hot metal of blank end into similar rounded head. Largely pre-riveted, girders need little at-site riveting.

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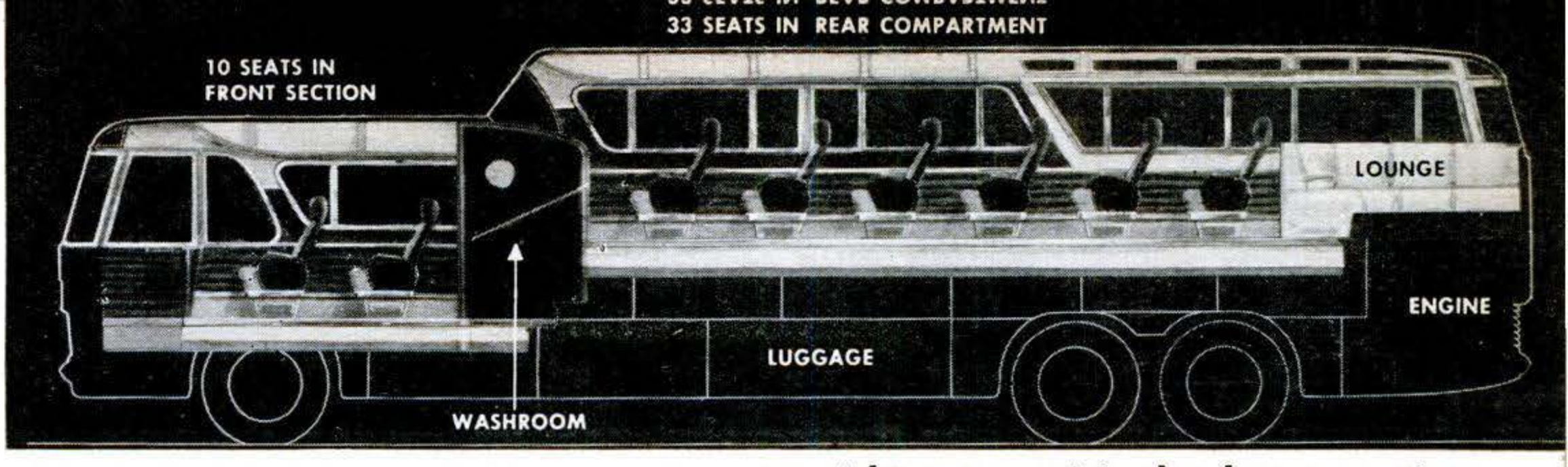
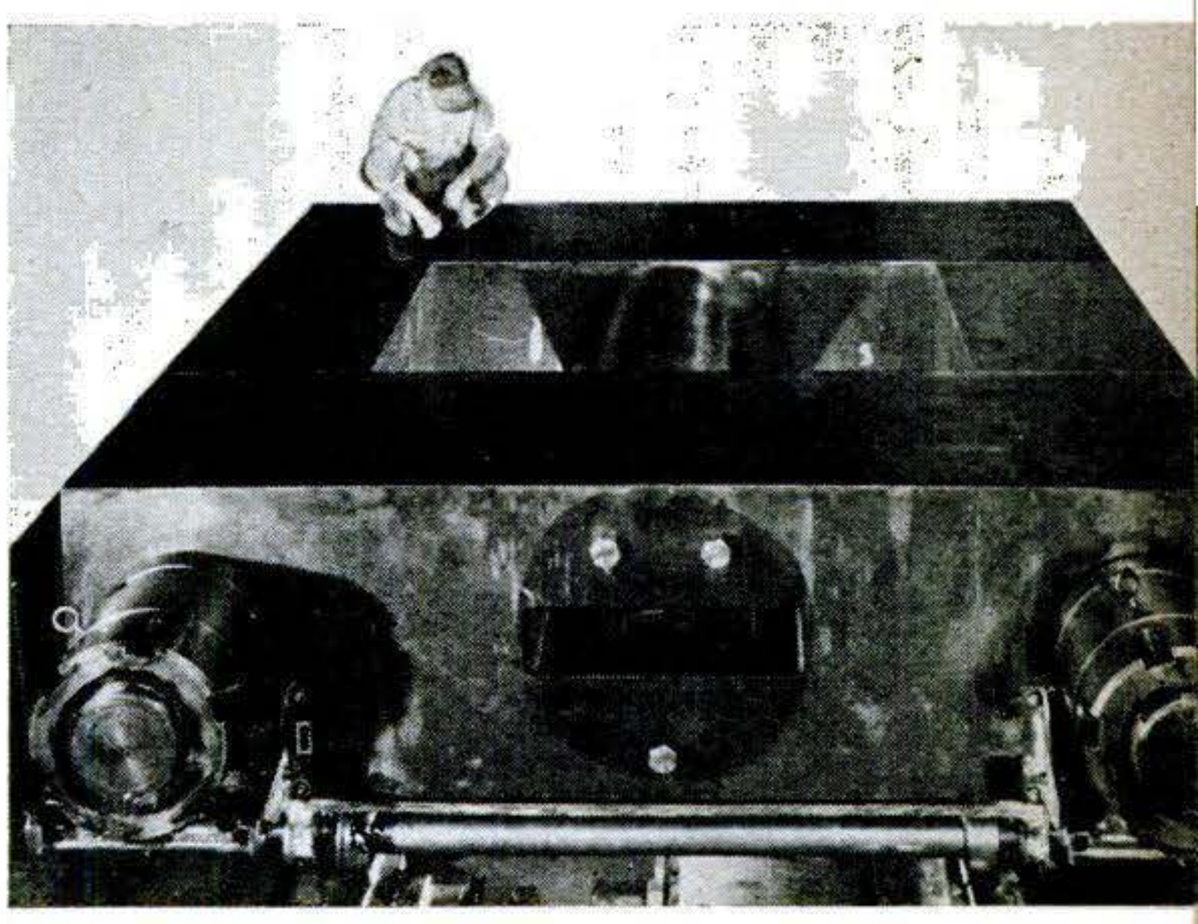


New Bus Lets Riders See Sights

DRIVER'S-SEAT vision for all 43 passengers is the goal of this Scenicruiser® bus now under test by Greyhound. The raised rear compartment is fitted with a curved windshield and safety-glass roof panels, glare-proofed for sunny weather. At extreme rear, an eight-seat, semicircular lounge section faces observation windows that curve clear across the bus. Three steps lead down to the front section. The bus is air-conditioned, has a public-address system, hydraulic-powered steering mechanism, and toilet and washroom facilities. It is 40 feet long, compared to 35 feet for most conventional buses.

Magnet to Curve Cosmic Rays

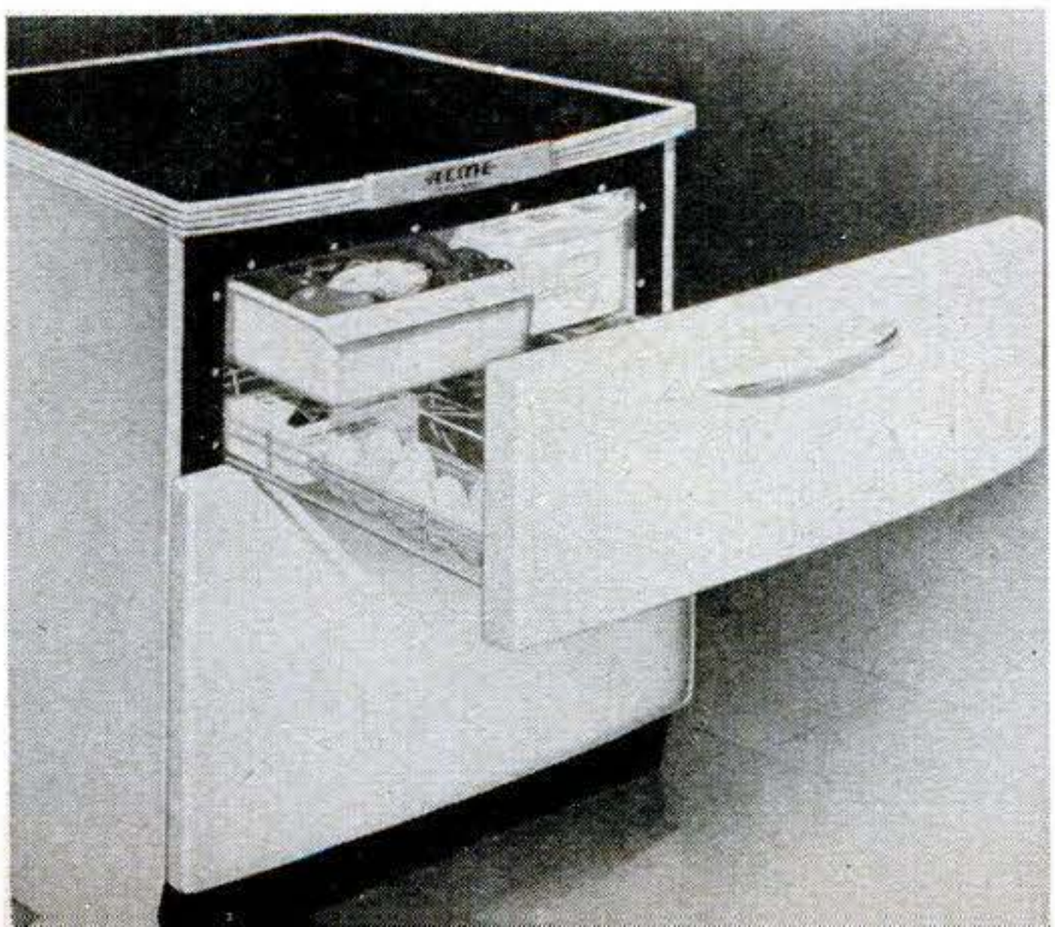
SEVENTY tons of carefully forged and machined steel form the core of a giant magnet (right) that nuclear scientists will use to bend cosmic rays. The magnet is part of a new pressurized cloud chamber being built at Brookhaven National Laboratory to learn more about the mysterious, powerful rays from outer space. The magnet core was forged by the Bethlehem Steel Co. It will support 10 tons of copper coils through which four Diesel-driven generators will feed 12,000 amperes of electric current to produce a potent magnetic field.



Refrigerator Uses Drawers

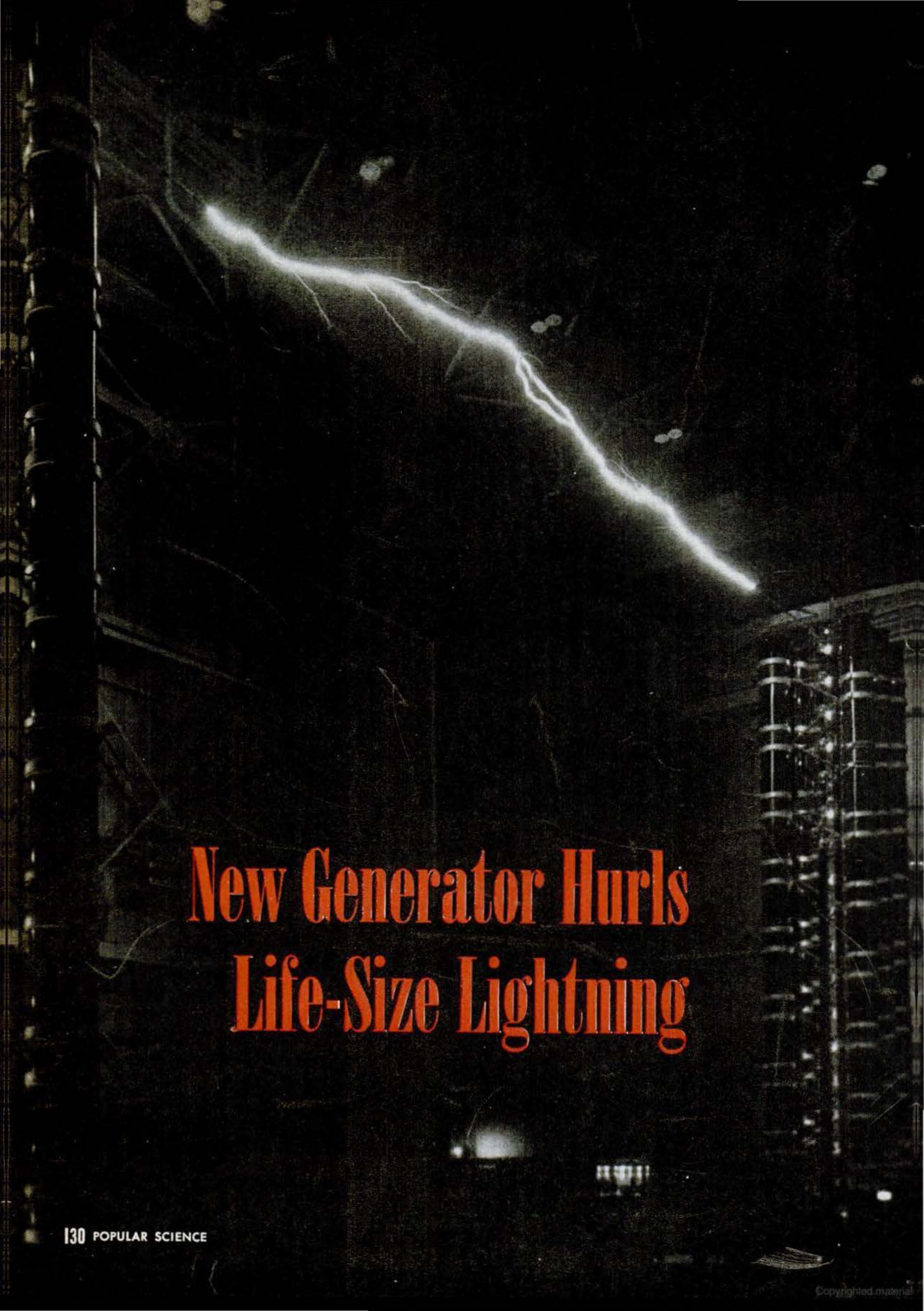
YOU needn't dig for items in the back of this new True-Zone® refrigerator. Instead of a door, it has drawers like a filing cabinet.

The flat Formica® top, 36 in. high, adds kitchen work space. Drawers have rustproof slides and nylon rollers that need no oiling. The deep bottom drawer holds tall bottles. Acme National Refrigeration Co., Brooklyn, makes the refrigerator.



Combine Cools Driver

WHEN the mercury soared over 90 in his Kansas wheatfield, farmer John Blackwell added a new attachment to his combine—a cooling blower fan. Shown below, it shoots fresh air down through a hole in an improvised roof onto the operator. A belt connected to the combine's elevator sprocket drives the fan. Though the air itself is hot, the blast cools by causing evaporation.



New Generator Hurls Life-Size Lightning

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Engineers wield man-made thunderbolts in awe-inspiring tests of electric devices.

By Alden P. Armagnac

PS photos on location by W. W. Morris, pages 130, 131, 132, 135.

IF LIGHTNING struck within a few feet of you, and you were lucky enough to stay alive, what would it look and sound like?

Standing behind protective wire grating in a hangarlike building at Pittsfield, Mass.. you can safely learn the answers. You see a narrow streak of yellow-white light so brilliant that its branching pattern impresses itself on the retina of your eye—and is still visible, with your eyes shut, for some little time. Simultaneously you hear a crash like a big gun firing, but, surprisingly, not too loud for unprotected eardrums to stand.

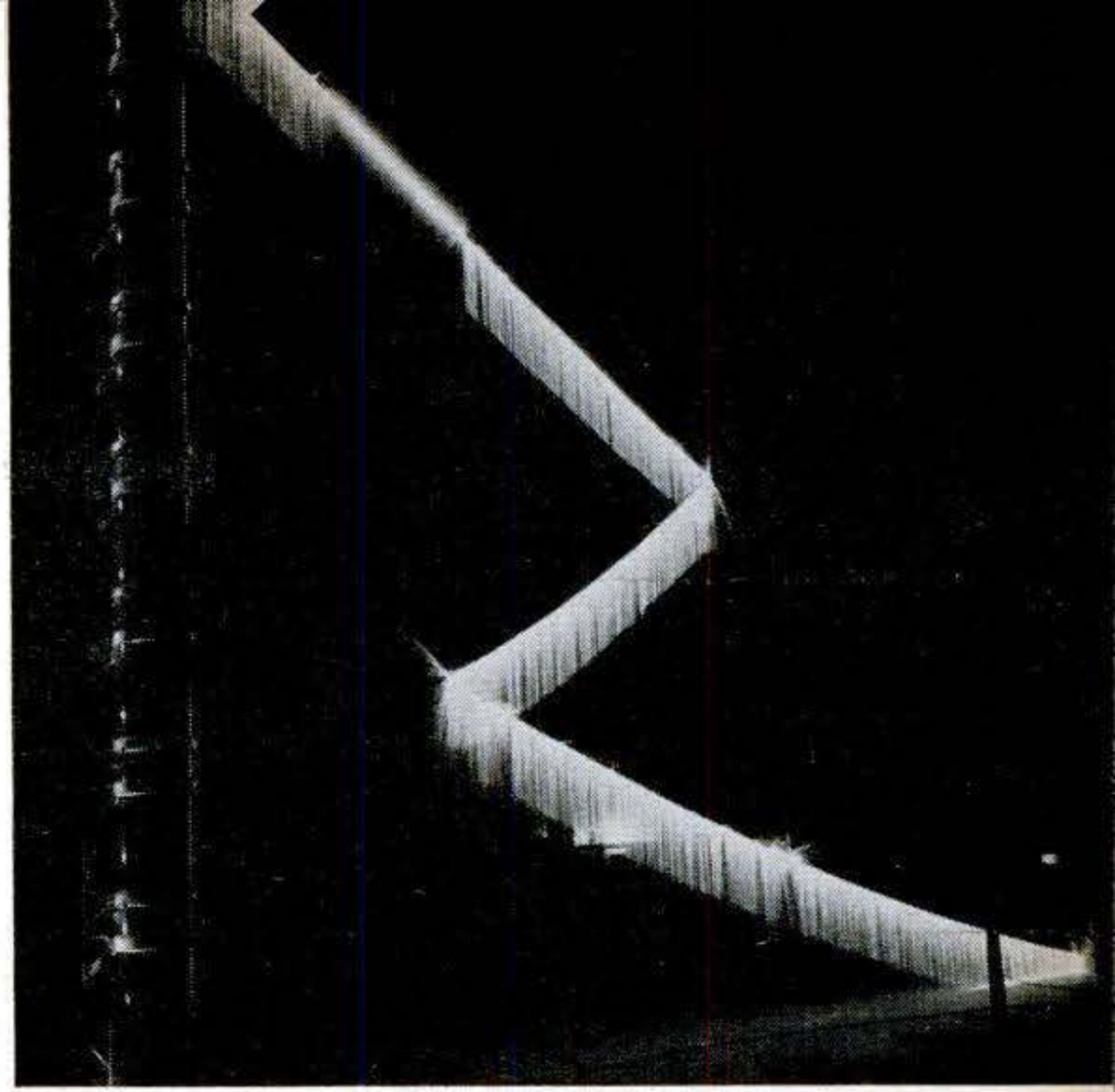
In this building, General Electric engineers have just placed in operation the mightiest artificial-lightning generator ever built. For the first time it enables them to duplicate the "business end"—the part that strikes buildings, trees, and power lines—of natural lightning bolts up to well-above-average power and destructiveness.

Their new "life-size lightning" machine hurls an awe-inspiring thunderbolt of 15,000,000 volts for a record distance of 50 feet through the air. For the few millionths of a second that the giant spark lasts, the generator delivers a 33,000-ampere flow of current. It would take a conductor of solid copper at least seven inches in diameter to carry so many amperes continuously.

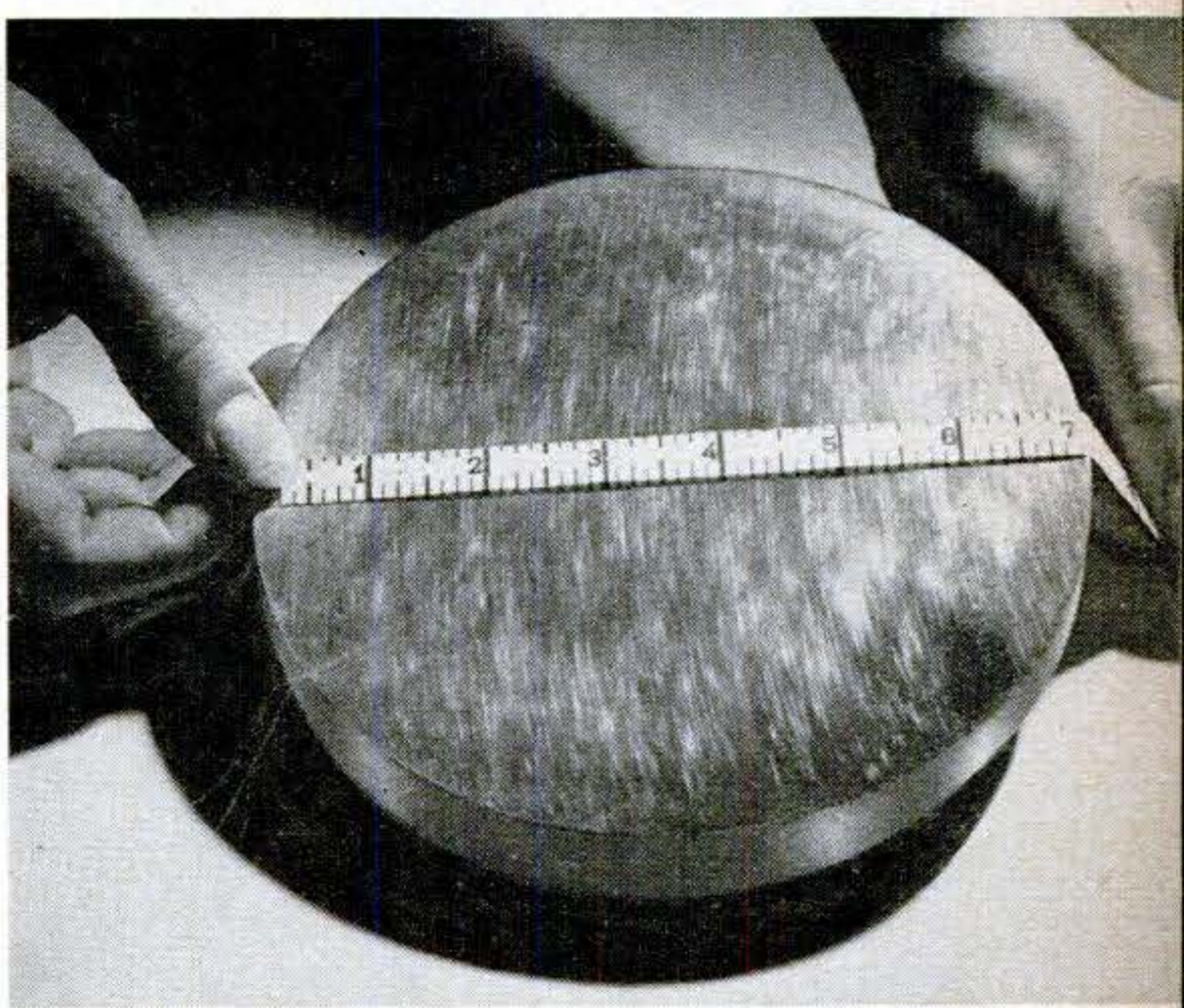
Compared with the largest previous artificial-lightning generator, the one whose 30-foot arc of 10,000,000 volts thrilled New York World's Fair visitors a decade ago, the new one unleashes half again the voltage and nearly twice as many amperes. Momentarily its power exceeds that of all the hydroelectric power stations in the United States combined!

Spectacular pyrotechnics occur when

This is it—real lightning! Fifty-foot bolt of 15,000,000 volts, mightiest ever produced by man, matches natural ones of above-average power. Its thunderclap sounds like big gun.

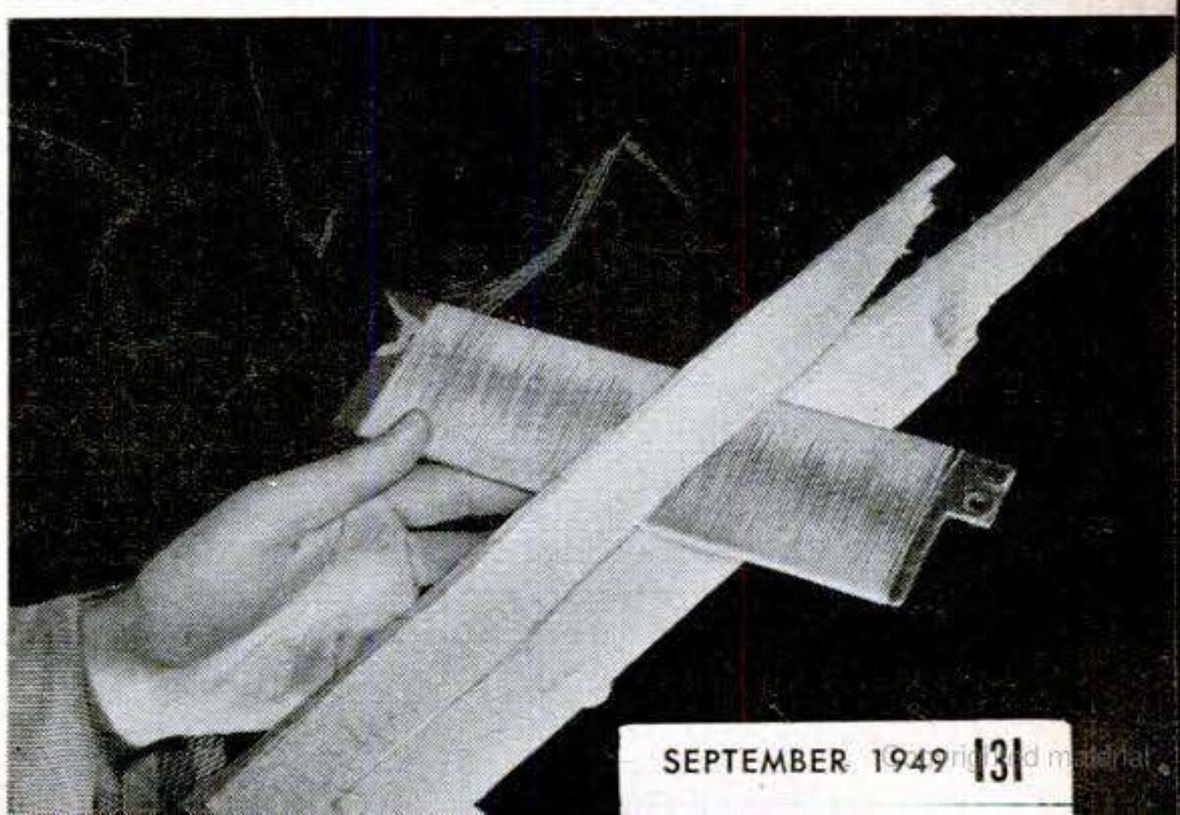


Thin copper wire, strung in zigzag pattern, vanishes in shower of molten sparks as man-made lightning from generator hits it. Sparks fell this far before camera's shutter closed.

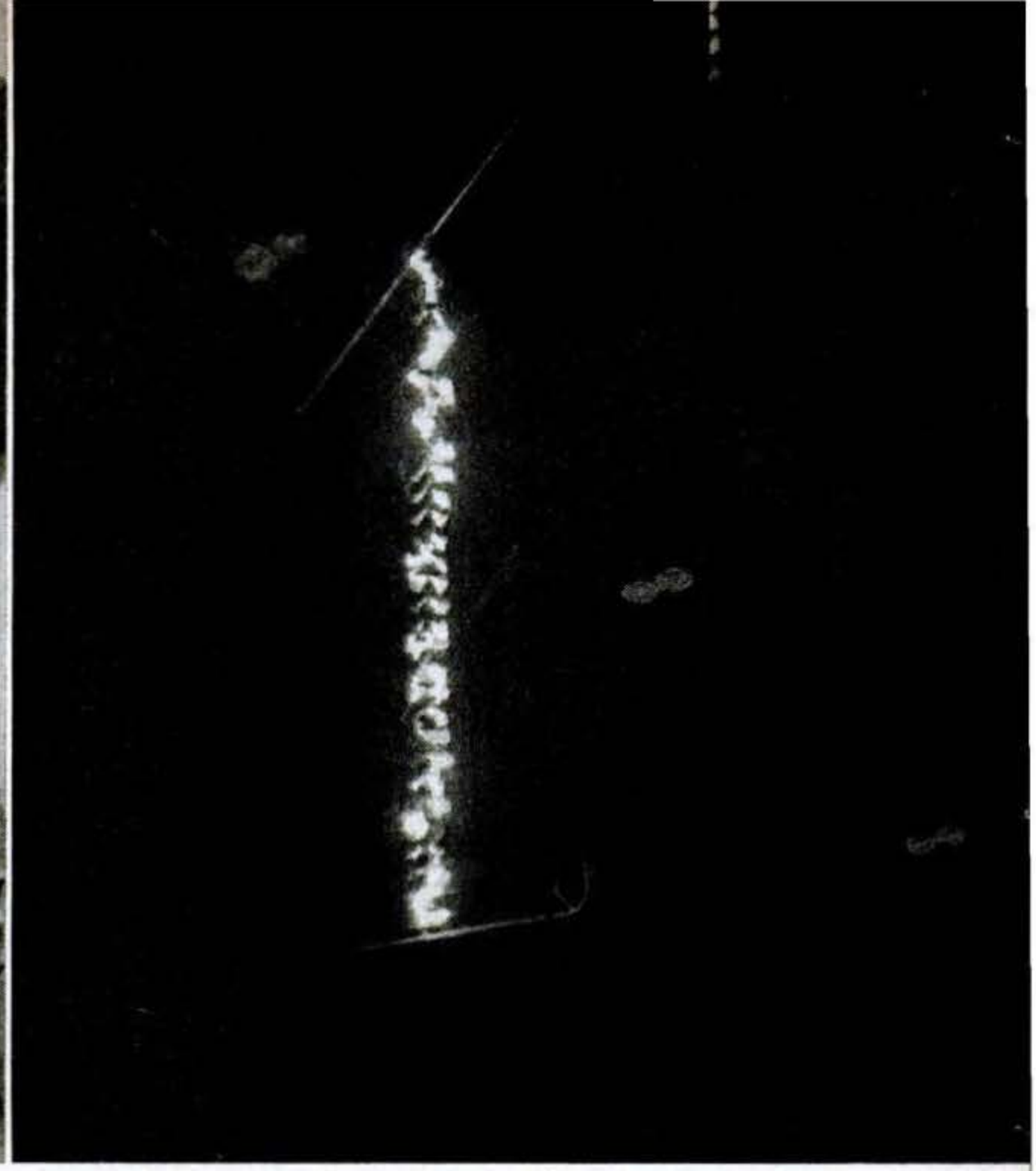


For split second, new generator yields 33,000-ampere flow of current—an amount that would need a solid copper conductor of at least the thickness above to carry it continuously.

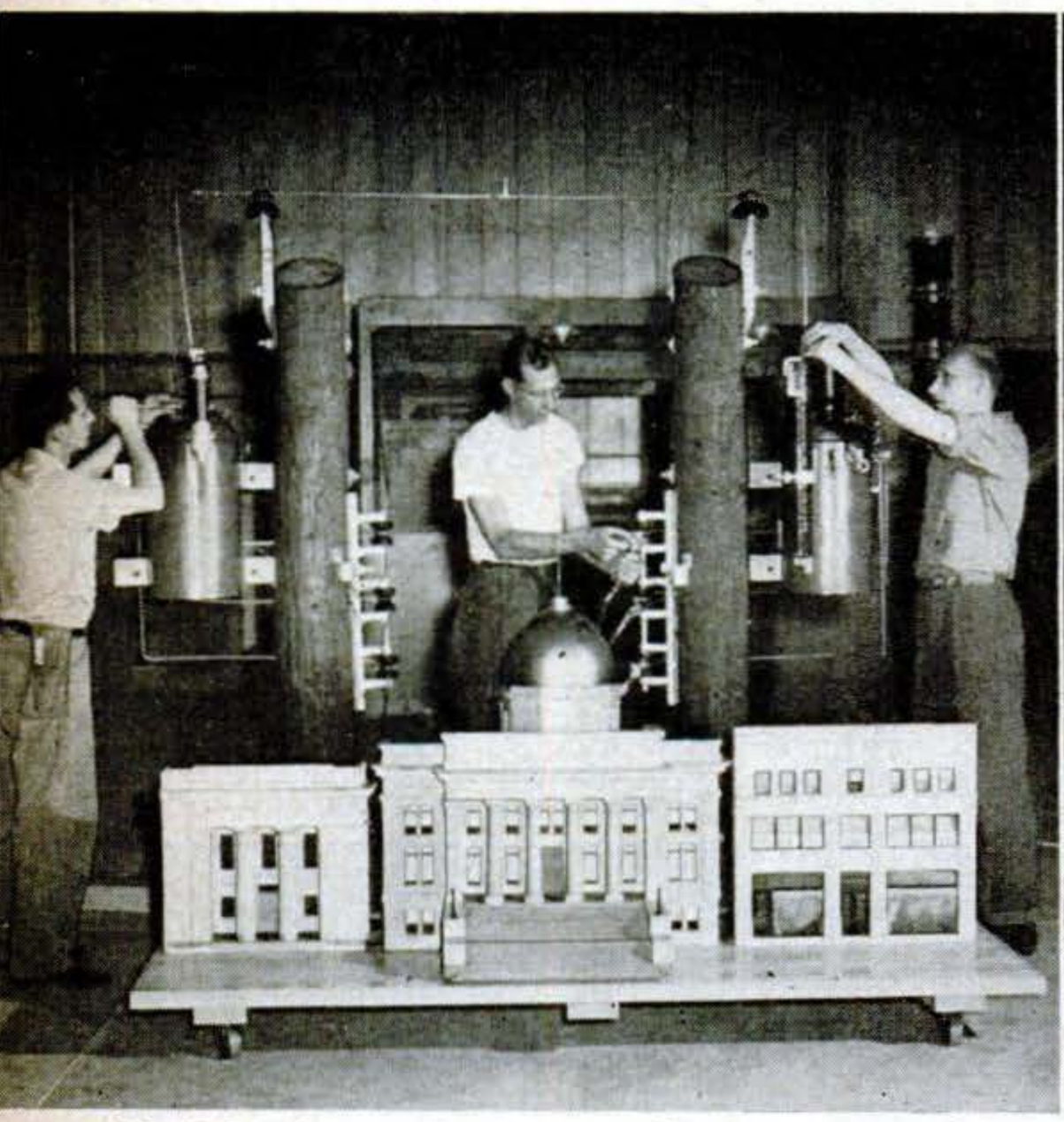
When man-made thunderbolt hit block of wood, this fragment (below) was hurled 50 feet. It struck a rack of resistors with such force that one was embedded in it as shown.



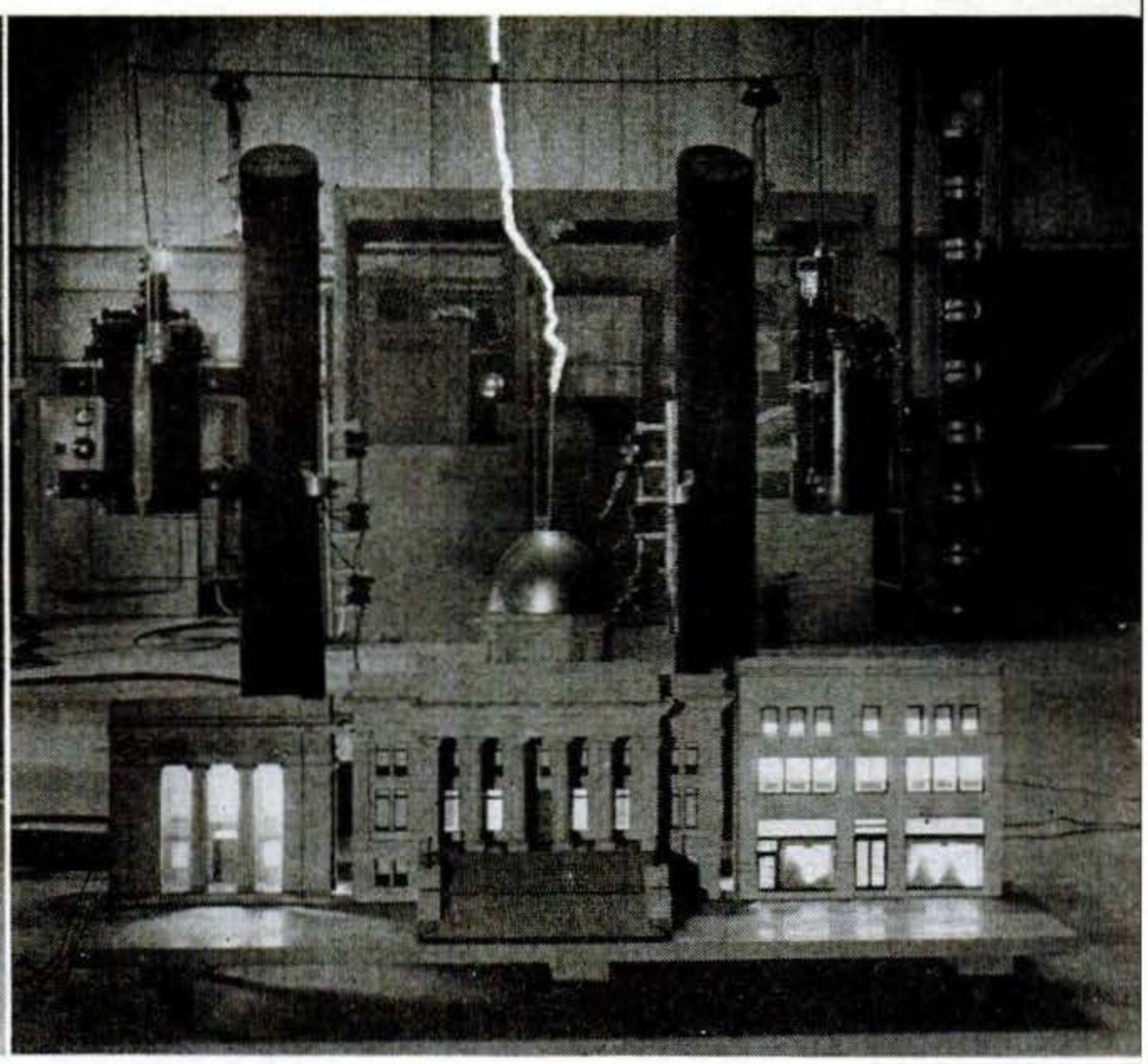
Operator touches off lightning bolt by pressing this button, after 30-second build-up of charge on condensers and sounding of warning horn. Eyes to oscillograph, he can see wave shape of discharge. Protective wire grating shields his control booth from runaway flash.



Arc of lightning generator flashes over string of 30 insulators to measure setup's insulating effectiveness. (Twenty-four are most used commercially.) Generator builds up voltage until current leaps between top and bottom of string, producing the brilliant display shown above.



Model of city buildings, lit by power from transformers on pole behind it, shows how modern lightning arresters prevent power failure during electrical storm. Above, engineers are installing arresters on transformers. Grounded lightning rod protects buildings themselves.



Bolt strikes transformers without putting out lights burning in model, as lightning arresters by-pass stroke harmlessly to ground. In similar test of transformers without arresters, lightning blows fuses and lights go out. Generator's control booth is seen in background.

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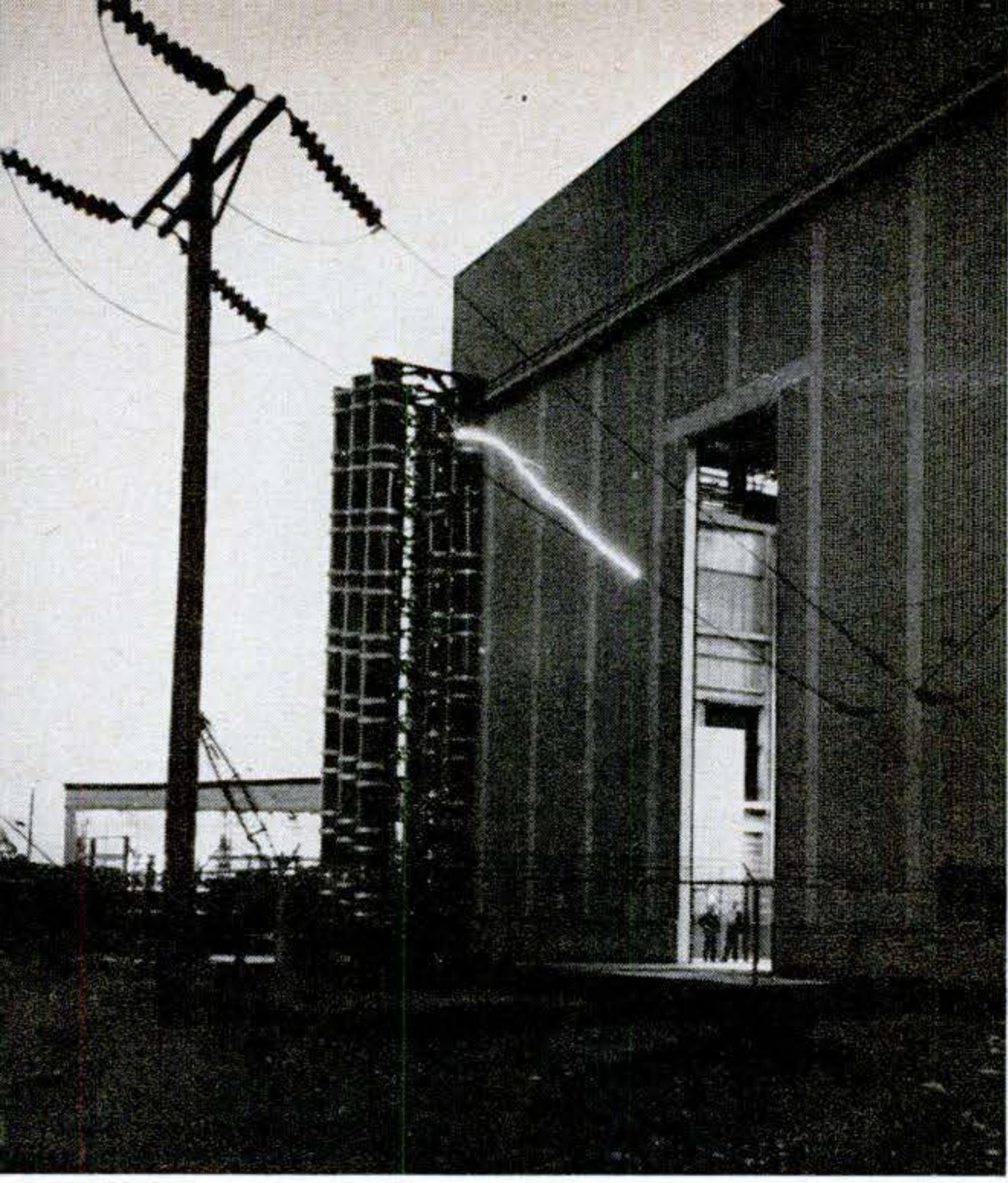
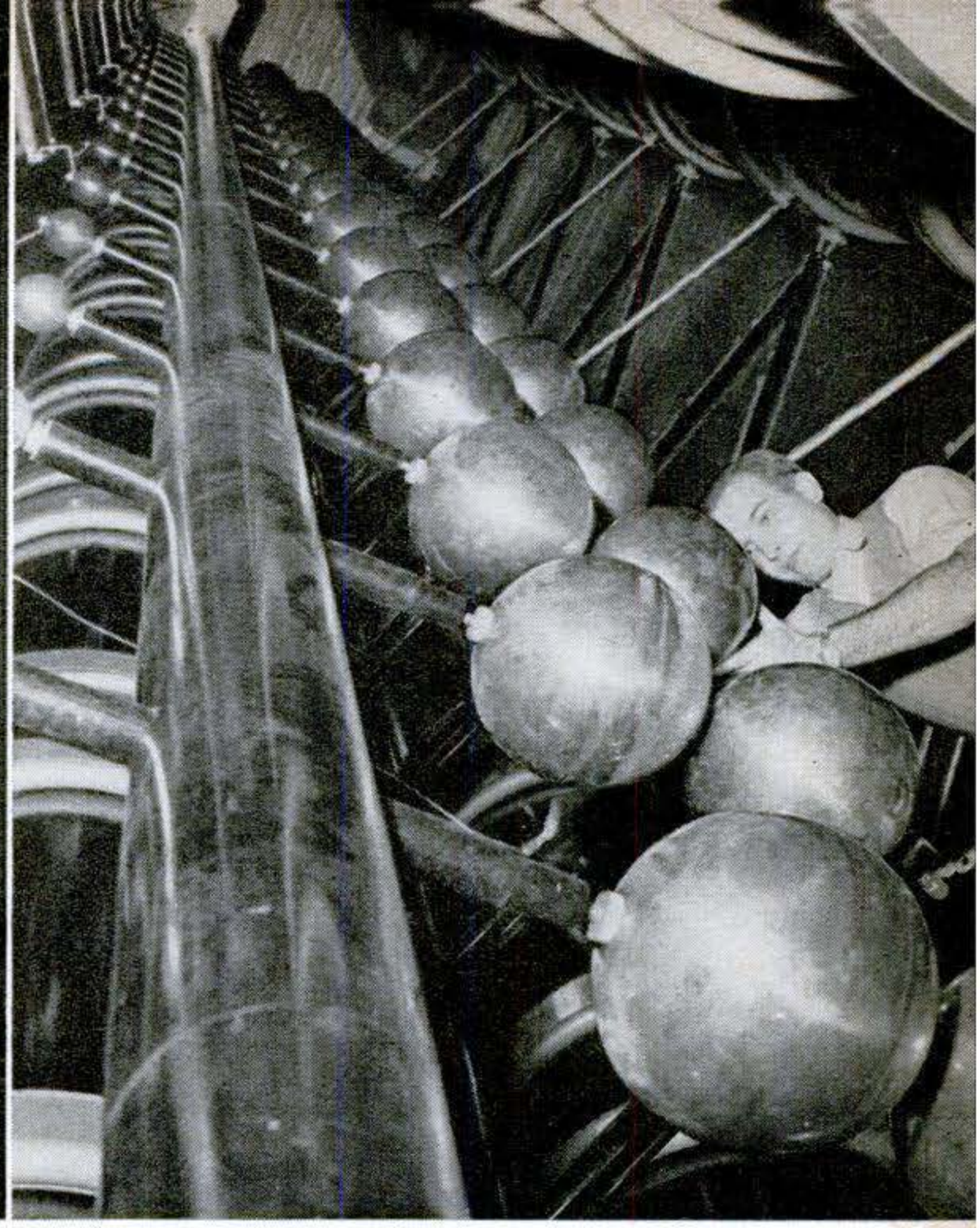


Moved outdoors, one of generator's twin sections hits transmission line with 25-foot bolt of 7,500,000 volts. Flash has been seen and heard two miles away. Portable section of generator rides rail car along track through high door in laboratory wall, seen open in picture.



Inside view of towering section of generator shows metal spheres that act as switches. A fly alighting on one of them alters the geometrically perfect spherical shape on which their delicate adjustment depends, and plagues experimenters by causing a premature discharge.

experimenters "short-circuit" the generator with a thin strand of copper wire and touch a button that releases the lightning bolt. Wham! The wire disappears in a puff of smoke and a fiery shower of molten sparks. That's presumably what happens, engineers suggest, to a radio aerial struck by lightning.

With the new generator, they tried a stunt they have performed with smaller ones—splitting a block of wood into kindling with artificial lightning. This time, a piece of the wood hurtled 50 feet through the air and crashed into a resistor rack, with such force that a resistor was found deeply embedded in it. Repeat performances were forthwith tabooed as too dangerous to spectators and equipment.

In more scientific tests, engineers use the new generator to find out what happens when natural lightning hits transformers, insulators, lightning arresters, and transmission lines.

An arc from the generator flames over a string of insulators, suspended high in the air, to measure their insulating effectiveness. And to study what happens to a power line hit by lightning, one of the generator's twin sections rolls bodily outdoors on a rail car, to bombard a 1½-mile-long experimental transmission line with a flash that has been seen and heard two miles away.

The generator is built in two, 44-foot-tall sections, each made up of black columns ringed with silvery stainless steel. Operating independently, each section builds up 7,500,000 volts, and their combined power gives the generator's 15,000,000-volt total. The black stacks are banks of electrical condensers, storing electricity as do the cumulus clouds or "thunderheads" of electrical storms.

For a 30-second charging period, current at comparatively moderate voltage feeds the condensers, which are connected meanwhile "in parallel"—like appliances you plug into a house circuit. That is, all the condensers get the same charge-building voltage, independently of the others. Then a tricky switching arrangement reconnects the condensers "in series," so that the voltage of the charge stored on each is added together to yield a thunderbolt. Invention of this "Marx circuit" by E. Marx in 1925 led to the first artificial-lightning generator

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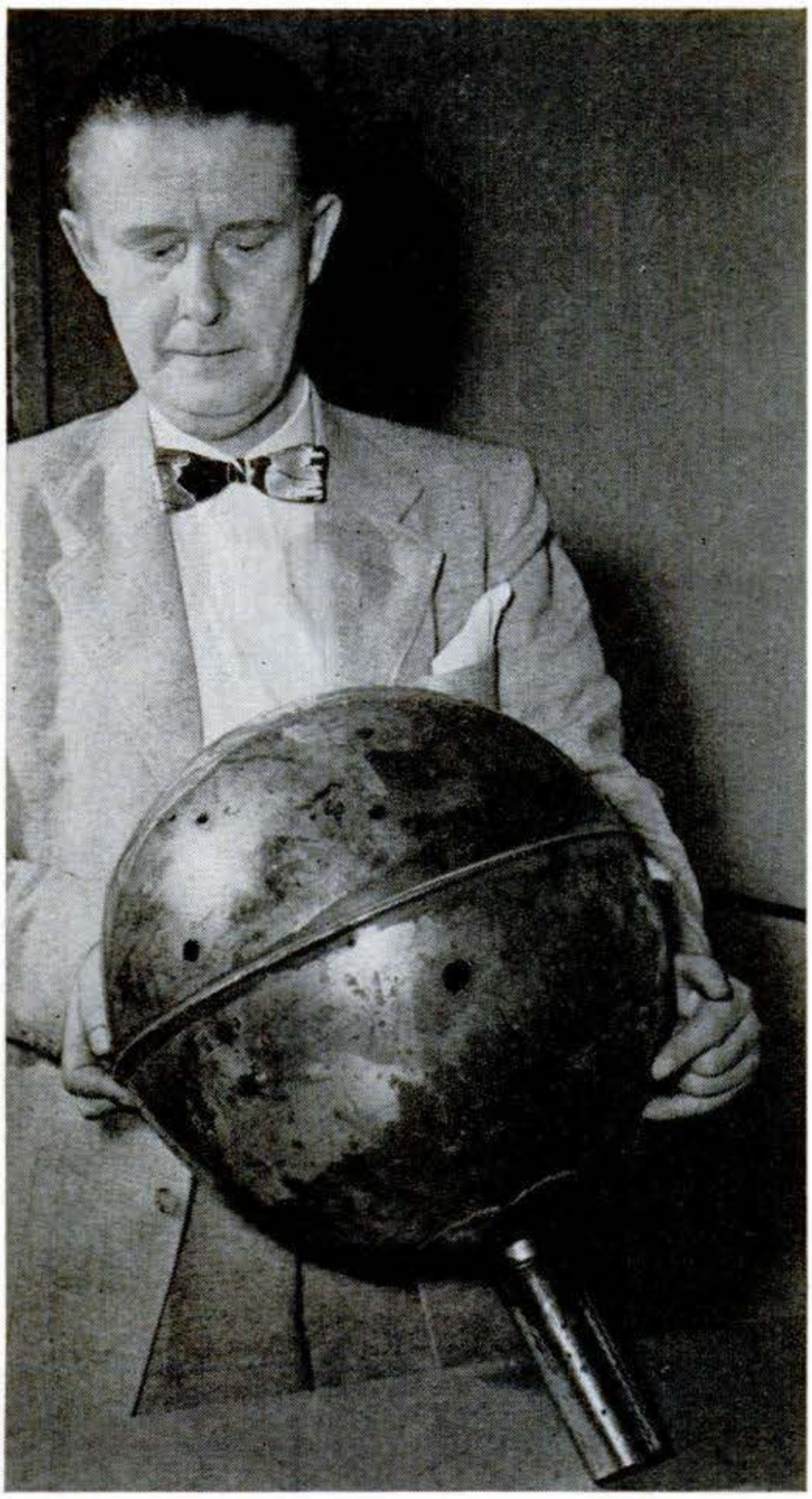
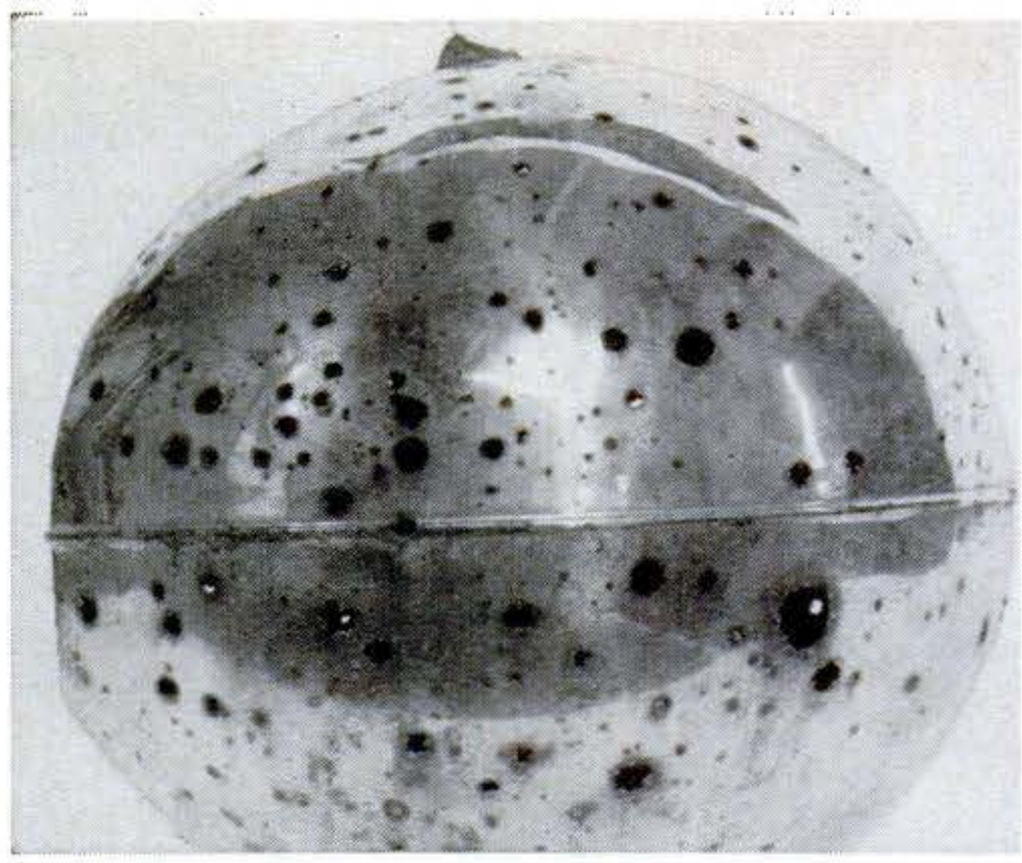
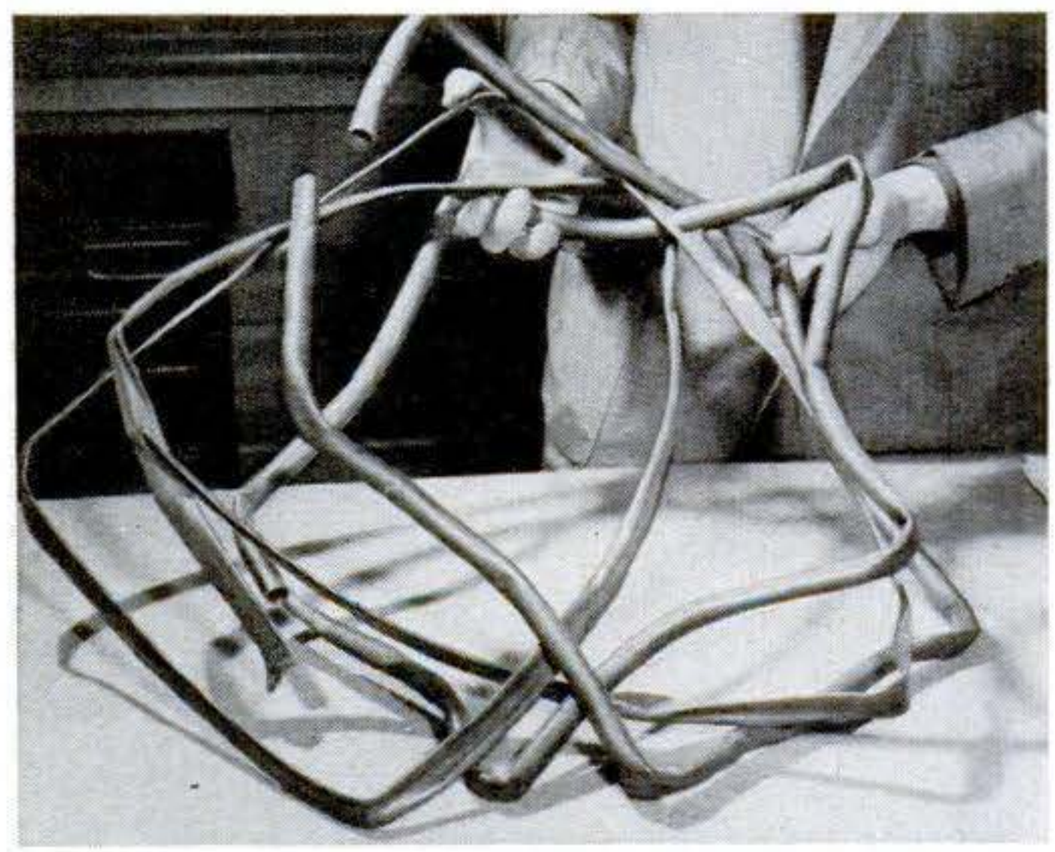


Artificial lightning, bombarding metal sphere exhibited by Julius H. Hagenguth, GE engineer, perforated it like sieve. Measuring current and time required to burn holes like those of sphere in photo at upper right yielded useful data on characteristics of natural lightning.

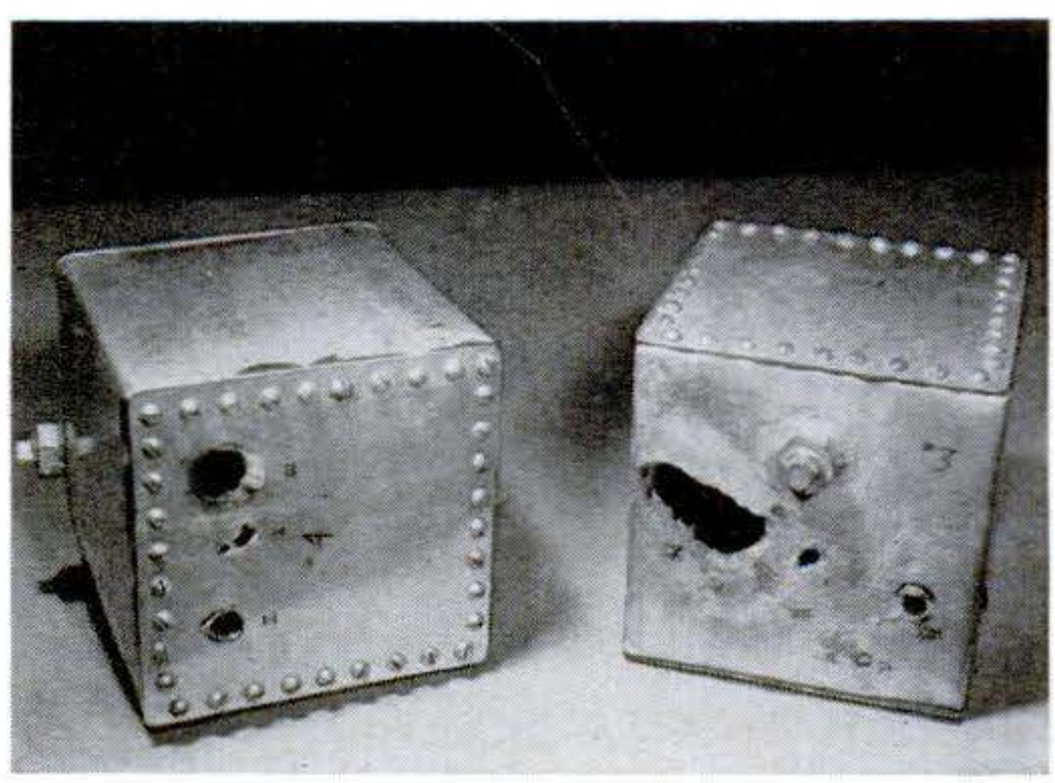


Lightning strokes burned 150 holes in ornamental nickel-plated copper sphere atop 878-foot Tennessee radio tower—then prankishly knocked it to earth, revealing their handiwork.



This once was a circular tuning coil in radio station WSM, Nashville, Tenn. Then lightning hit it. Magnetic effects of huge current crumpled coil and flattened copper tubing, as seen. Laboratory tests with copper tubing yielded similar effects at 75,000 to 118,000 amperes.

Lightning has hit many planes without harm to passengers or serious damage to craft. All-metal construction conducts stroke without dangerous sparks. DC-4 transport had only this small hole burned in pitot tube, where lightning hit it, as souvenir of experience.



Artificial-lightning tests on sample gasoline tanks, of 0.051-in. aluminum alloy, indicated that high-voltage spark would be fire hazard if it struck tank directly. Bolts of high-powered man-made lightning punctured sample tanks and ignited their inflammable contents.

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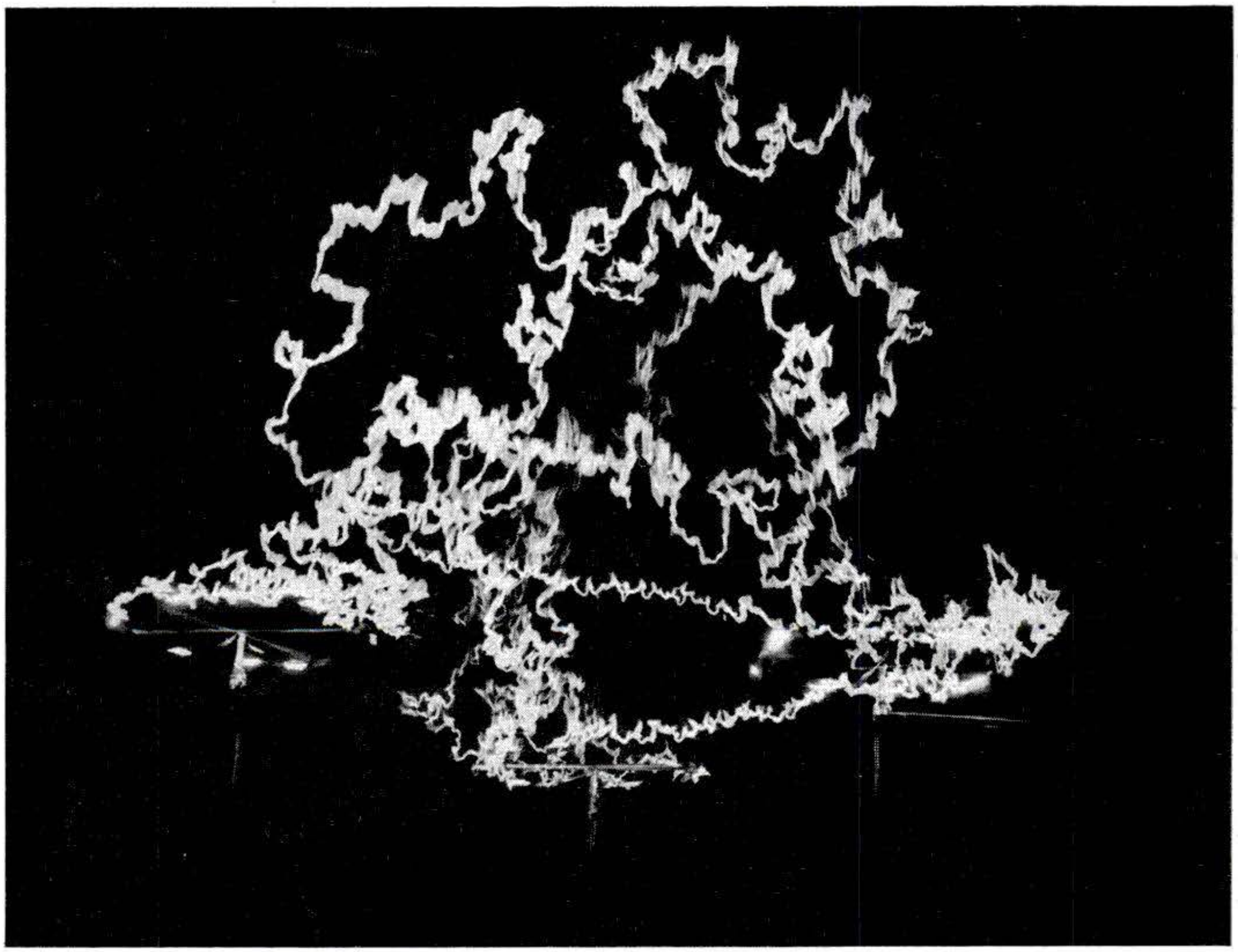
of 1,000,000 volts and its successors of increasing power.

Even the present 15,000,000-volt machine is far from the theoretical limit of voltage attainable by such an "impulse generator," declares Julius H. Hagenguth, engineer in charge of the GE high-voltage laboratory. By increasing the number of condensers, a still more powerful one could be built. Practical limits are the cost of the machine itself, against advantages to be gained, and the size of the huge building required to house it. Increasing voltage calls for more and more clearance from walls, ceiling, and other apparatus to prevent stray bolts. For the 15,000,000-volt machine, this minimum clearance is 33 feet. "High-Voltage Hall," its great windowless test chamber, measures no less than 165 feet long, 95 feet wide, and 85 feet high.

Three 1,000,000-volt, 60-cycle transformers share this enormous room with the black-and-silver towers of the new generator. Applied to a spark gap, their own discharge aids studies of high-voltage action—and incidentally creates one of the most beautiful of all displays of electrical fireworks, illustrated below.

Most impressive of the machines in adjacent rooms of the Pittsfield laboratory is a "high-current" impulse generator. It delivers the staggering current of 260,000 amperes with a respectable thunderclap of its own. While its artificial lightning lacks the voltage to leap great gaps, it will subject small test specimens to more than the record 200,000 amperes ever measured in a natural lightning stroke.

Virtually any of lightning's pranks, of which some are illustrated here, can now be matched by GE engineers with these machines. Using their findings to perfect economical and trouble-proof power-line equipment, they are constantly reducing the "electrical cost of living" for the ultimate consumer. END



Electric fire of 1,000,000 volts, from three-phase 60-cycle transformers, gives spectacular display as it leaps nine-foot gaps between rotating "pinwheel" electrodes. These whirl of own accord as electricity escapes from their backward-turned points. Arc is carried 20 feet high by heated air currents and is colored red, yellow, and green by chemicals tipping the three electrodes. Sound effect of electrical fireworks resembles drone of airplane, punctuated every few seconds by a sharp crack as a new arc is struck between pair of electrodes.

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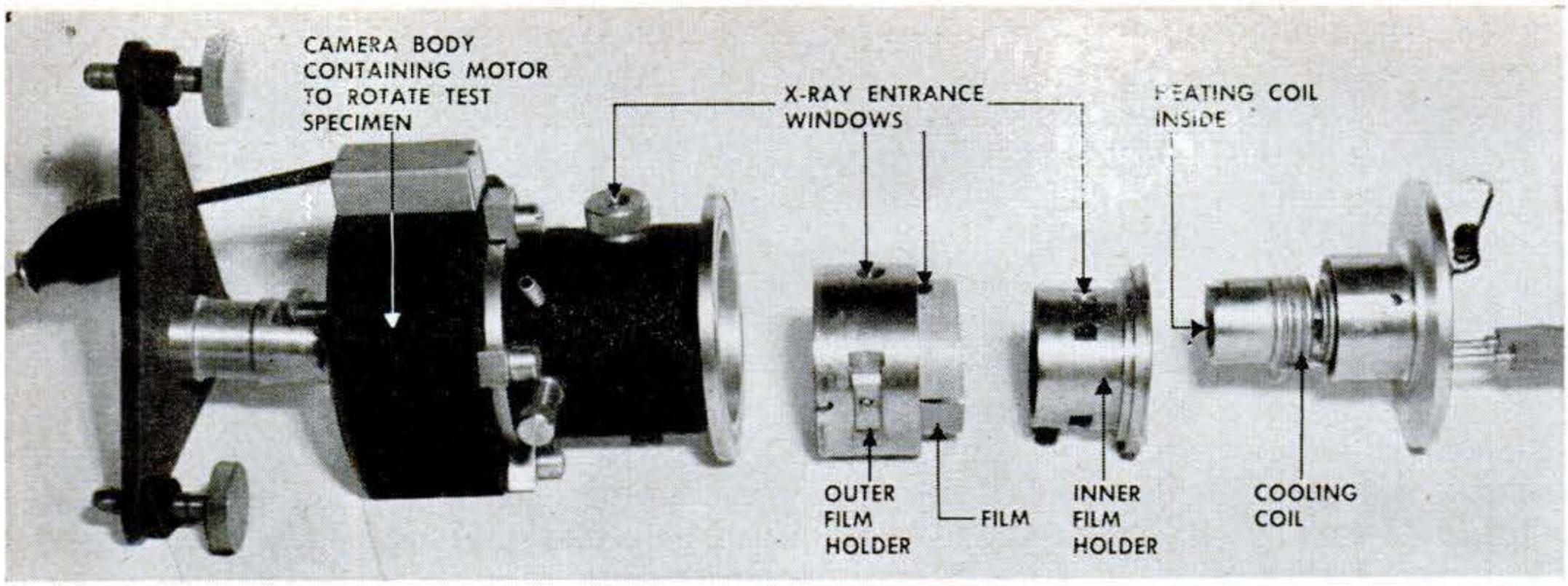
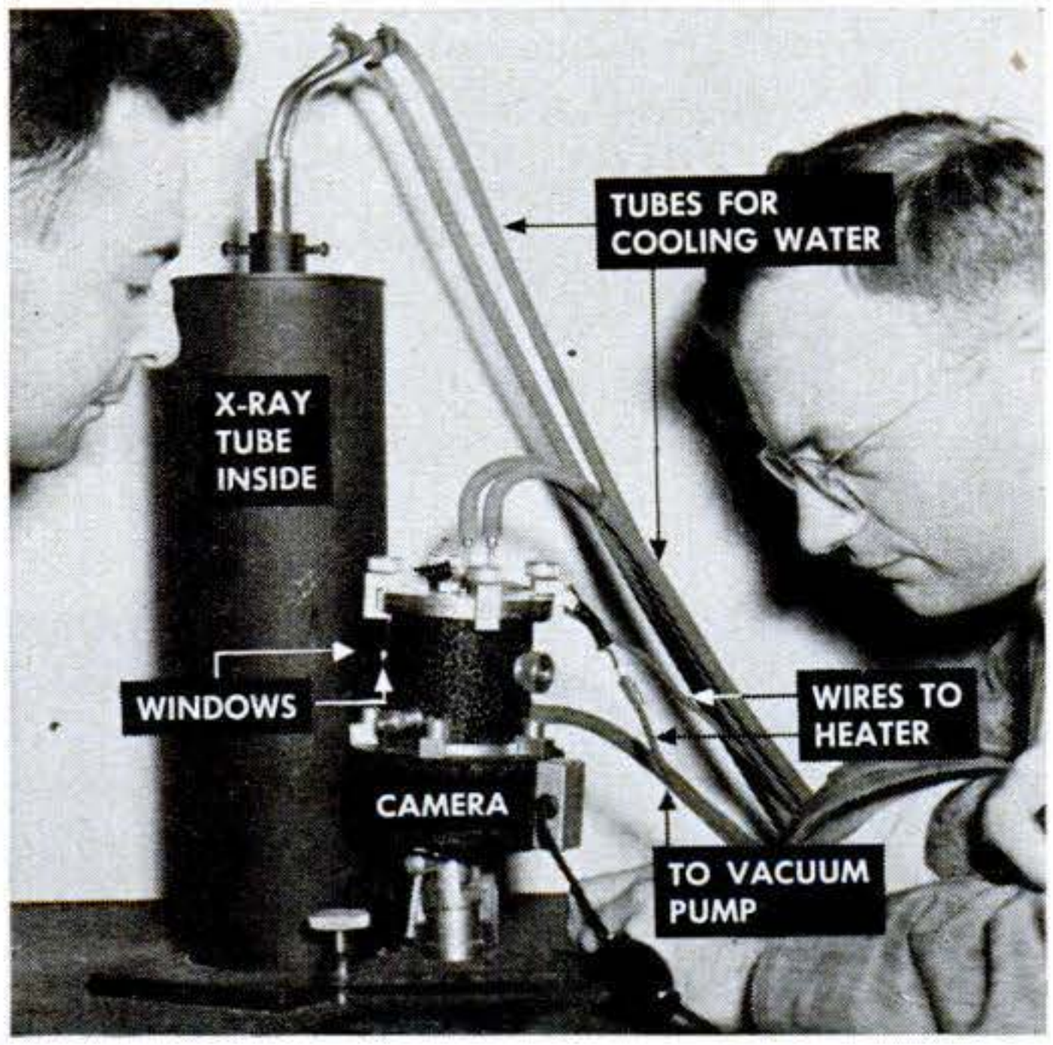
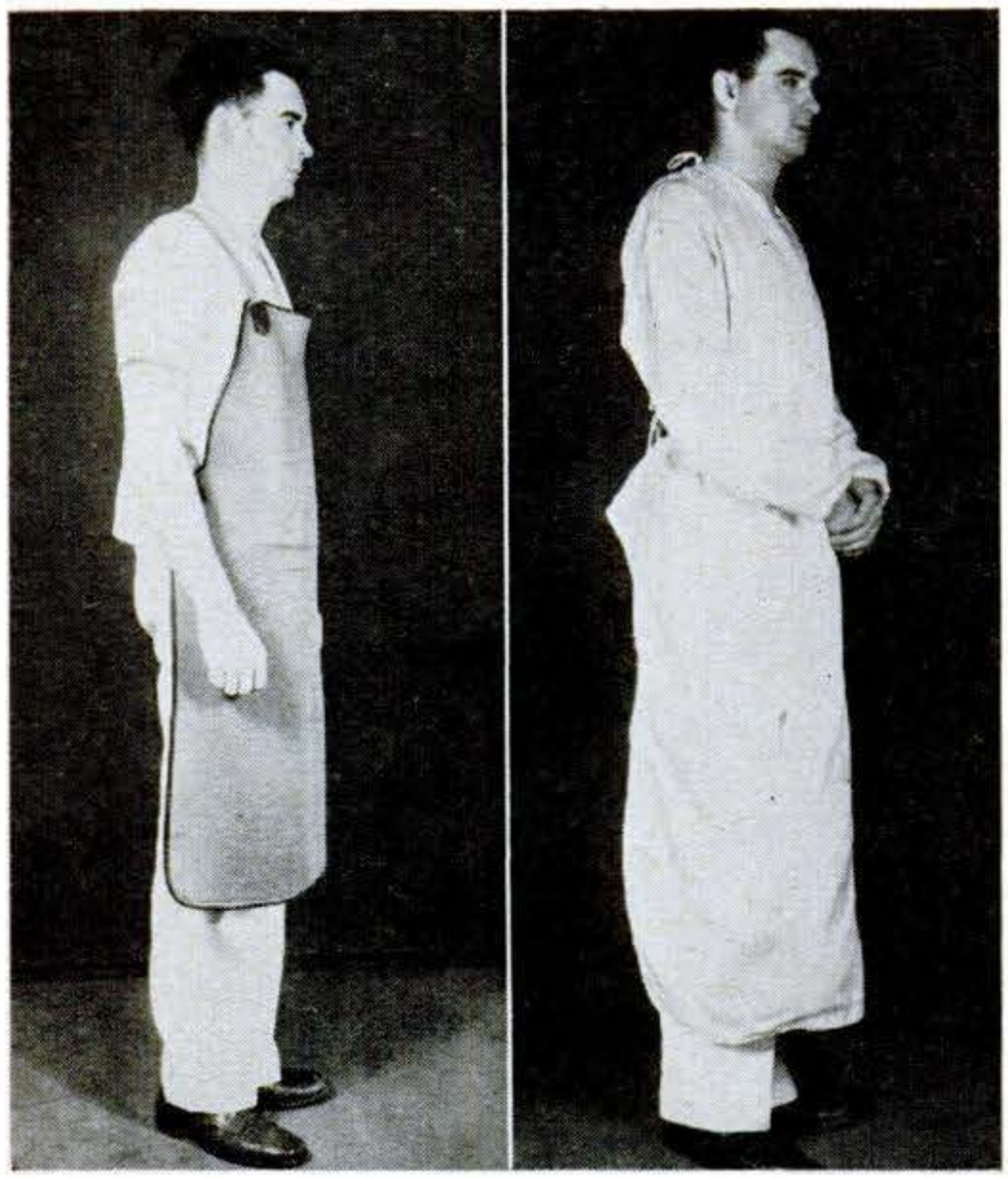


Hot Camera Tests Jet Metals

A NEW instrument shows metallurgists how alloys act at the high temperatures in jet and rocket engines. The device is a camera with a built-in electric furnace—shown disassembled above, and in use with an X-ray generator at right. It takes X-ray shadow pictures of the arrangement of atoms in the heated test specimen. Prof. Arthur A. Burr, of Rensselaer Polytechnic Institute, designed the new research instrument.





Glass Smock Stops Atom Rays

DECONTAMINATION crews in an atomic war might wear glass clothing to shield them against deadly rays. The smock at right above, made of lead-glass fiber, gives better protection than the apron of lead-filled rubber at left—yet weighs only two ounces more. Dr. V. W. Archer, of the University of Virginia, led the research.

Echo Room Helps Stop Noise

IT TAKES a noisy room to learn how to make one that'll be quiet. So Johns-Manville engineers test soundproofing materials in a two-story-high concrete room that creates sustained echoes (started by loudspeaker, top of photo). The reduction in echo time caused by different sound absorbers laid in the floor rates each one.

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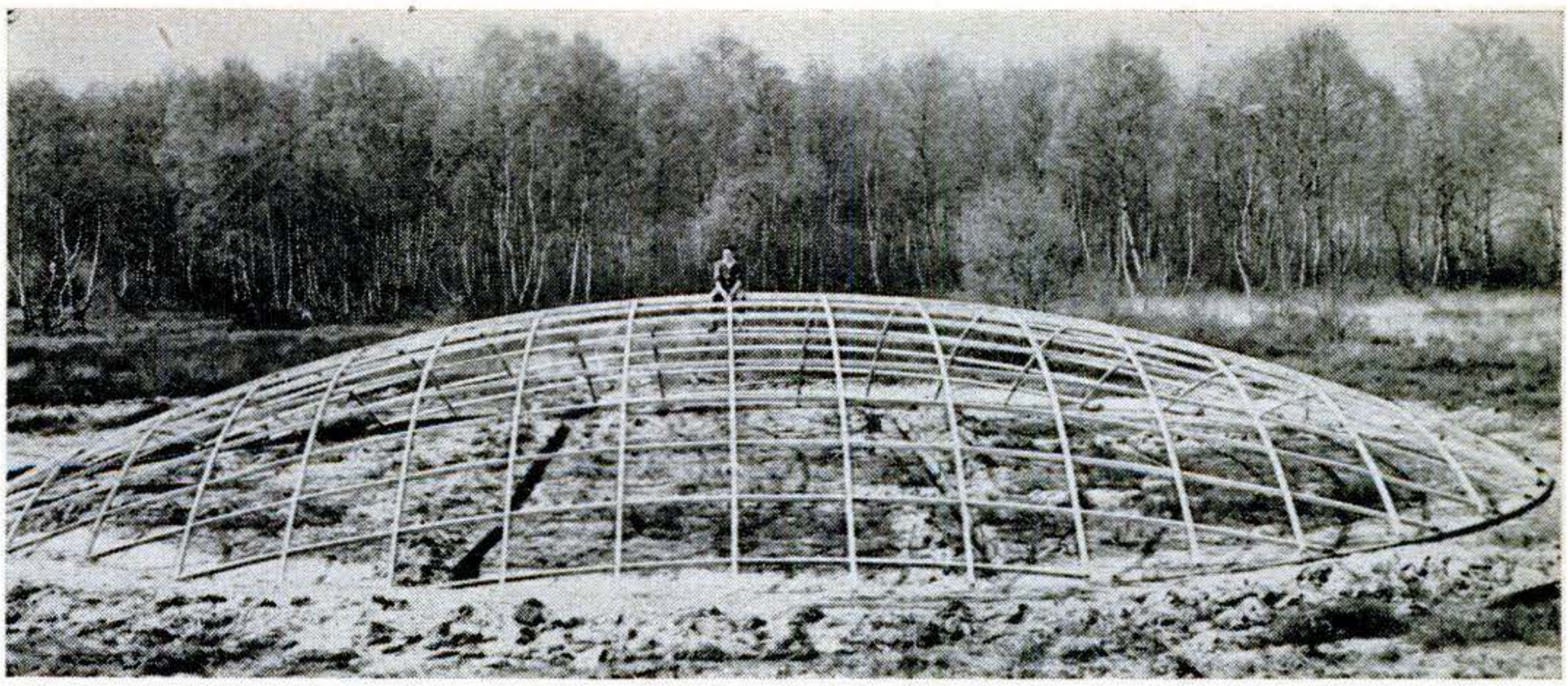
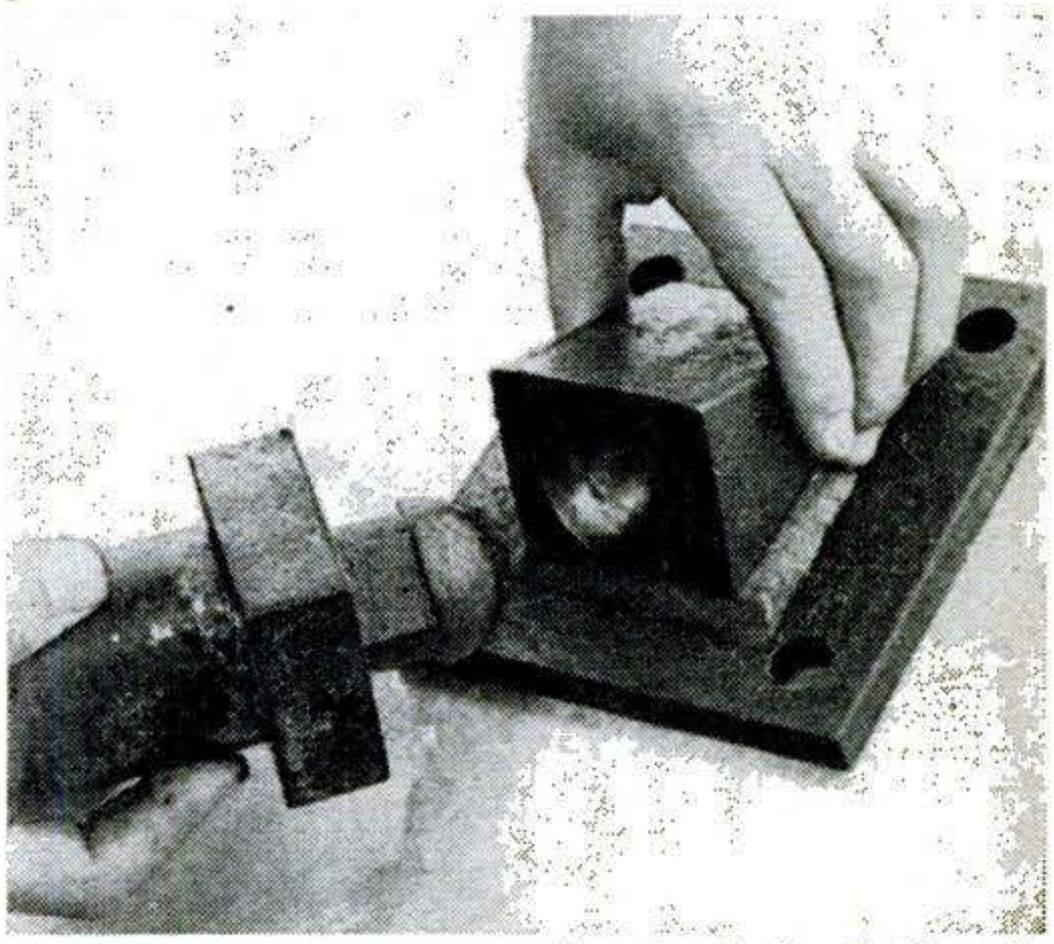


Aluminum-tube framework of the model of a new British "self-supporting" roof. Designers claim that structures with diameters of between 500 and 600 feet can be built by this method.

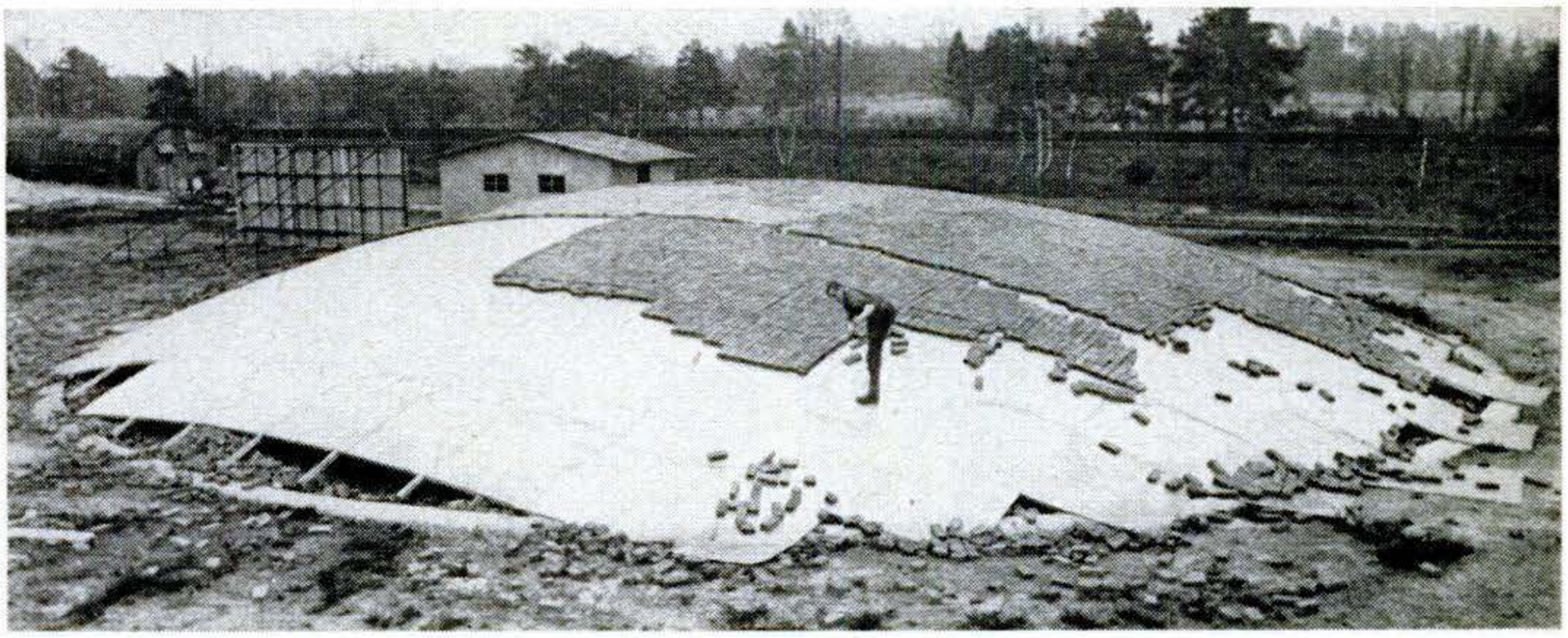
Aluminum Roof Strong as Steel

SINCE mathematicians can't figure out exactly how much weight a spherical shell will support before caving in, British engineers tested out such a structure by simply piling bricks on it. As a result, they claim that a new aluminum roof of this design is as strong as a similar steel one.

Designed as a roof for oil or chemical storage tanks, the new structure consists of a criss-crossed framework of aluminum tubing covered with aluminum sheeting. Shown here is the experimental model, 83 feet in diameter with a nine-foot rise, that was brick-tested for strength.



Close-up above shows detail of the ball-and-socket shoes used to support rib ends of aluminum-tube network. Six men can erect the framework and weld shoes to outer ring in one day.



After framework had been covered with aluminum sheeting, bricks were piled on as shown above. With a load of 27 pounds per square foot, tests revealed no appreciable strain.

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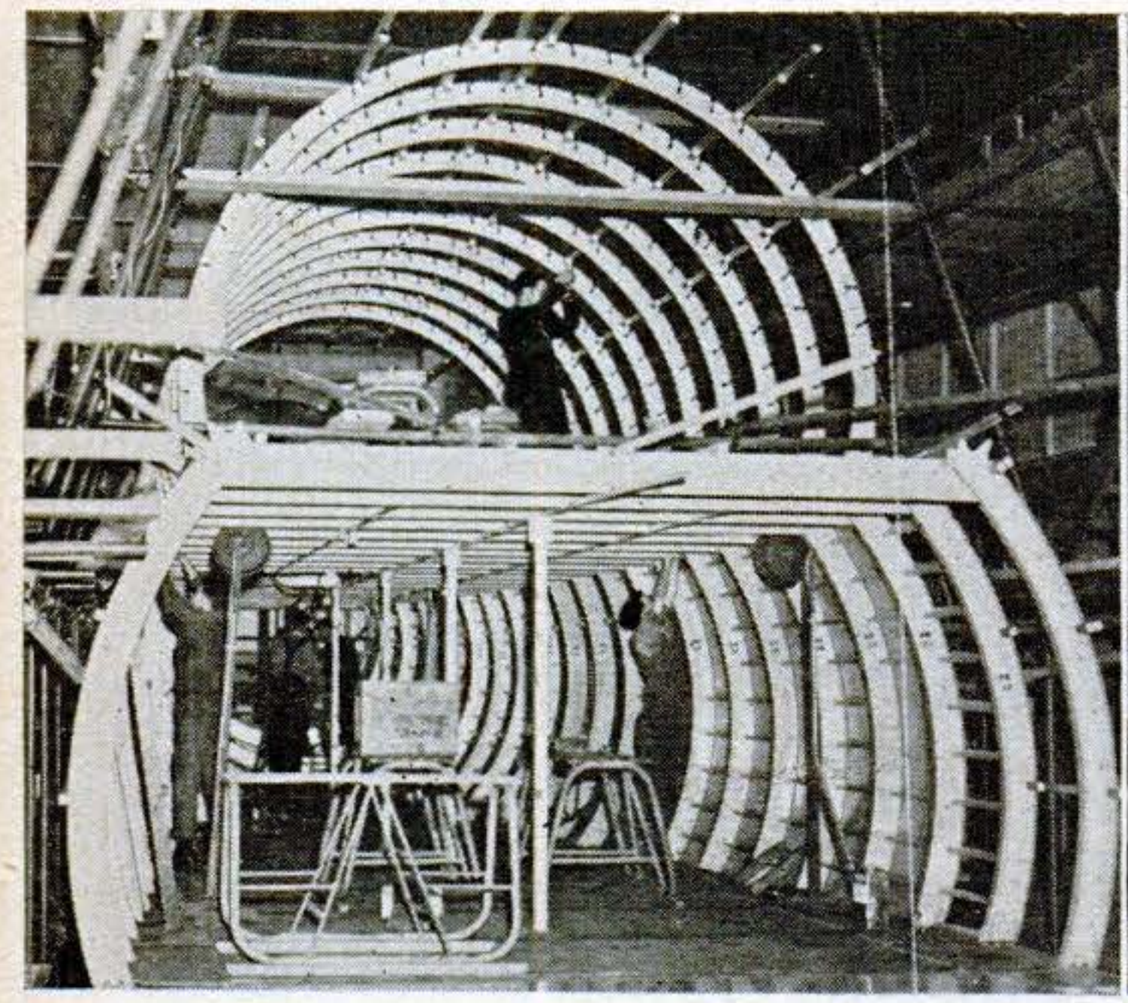
10 Turboprops Power Giant Flying Boat

Model of 10-engine, long-range flying boat shows the high wing and single fin and rudder.

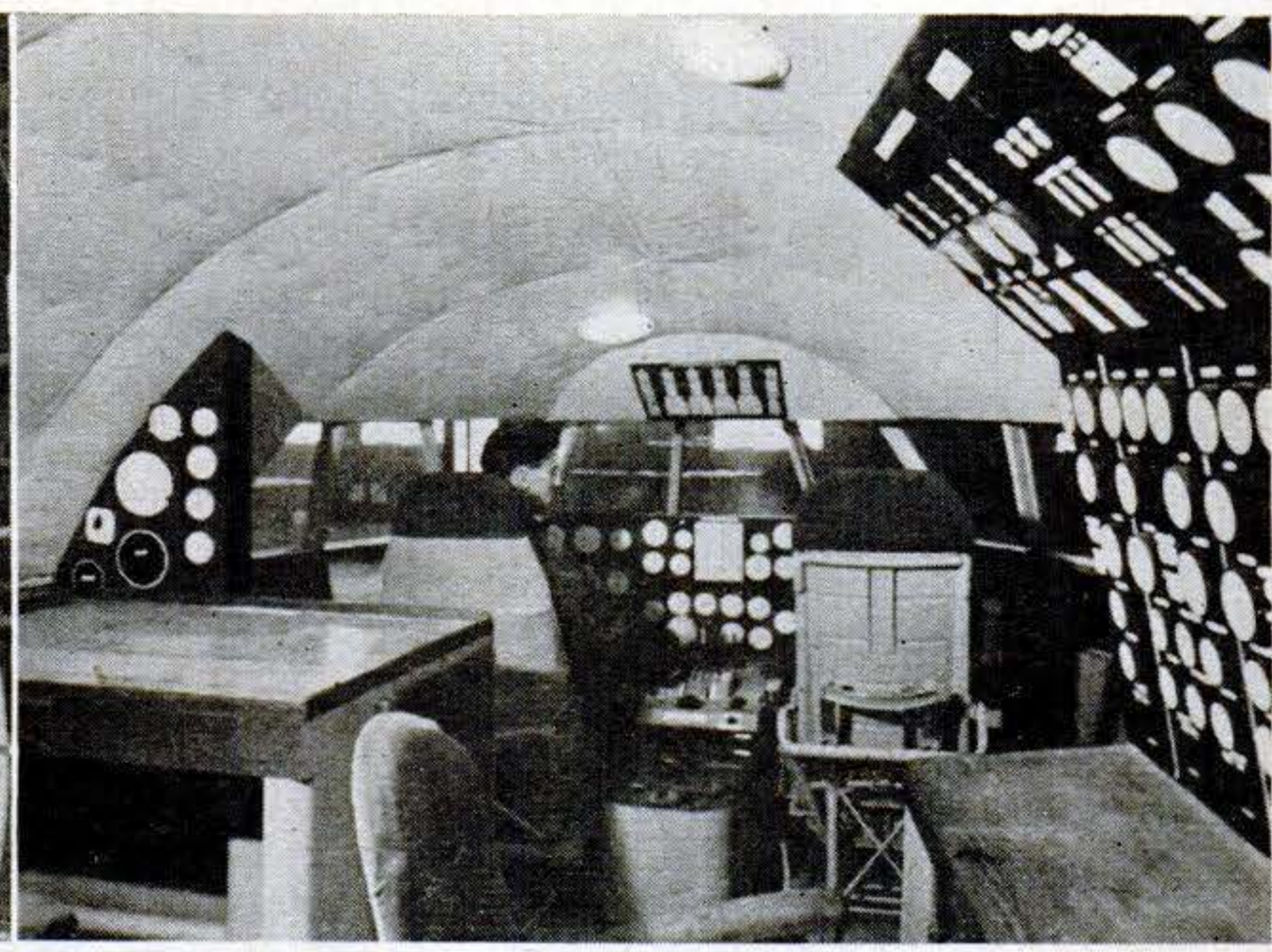
BRITAIN'S faith in flying boats and turboprop propulsion is borne out by the huge Saunders-Roe 10-engine Princess®, now nearing completion at Cowes, Isle of Wight.

Designed for flights across the Atlantic to South America, the SR/45 will accommodate 85 passengers, plus a crew of 14. The latest in aerial luxury planning, the plane will have quarters with the comfort and privacy of an ocean liner's cabins. Provisions have even been made for a miniature nursery, complete with toys and sandpit.

The new flying boat is of double-deck design, similar to that of the U. S. Boeing Stratocruiser®. It will be powered by 10 Bristol Proteus® turbine engines, driving 10



Finishing touches are put on skeleton of the double-bubble fuselage. Hull of the flying boat will be 150 feet long; wingspread will be 220 feet. Landing floats will retract into wings.



This view shows roominess of the pilots' cockpit and the control room. Flight crew of the plane will include five stewards. Plane's decks will be connected by stairways fore and aft.

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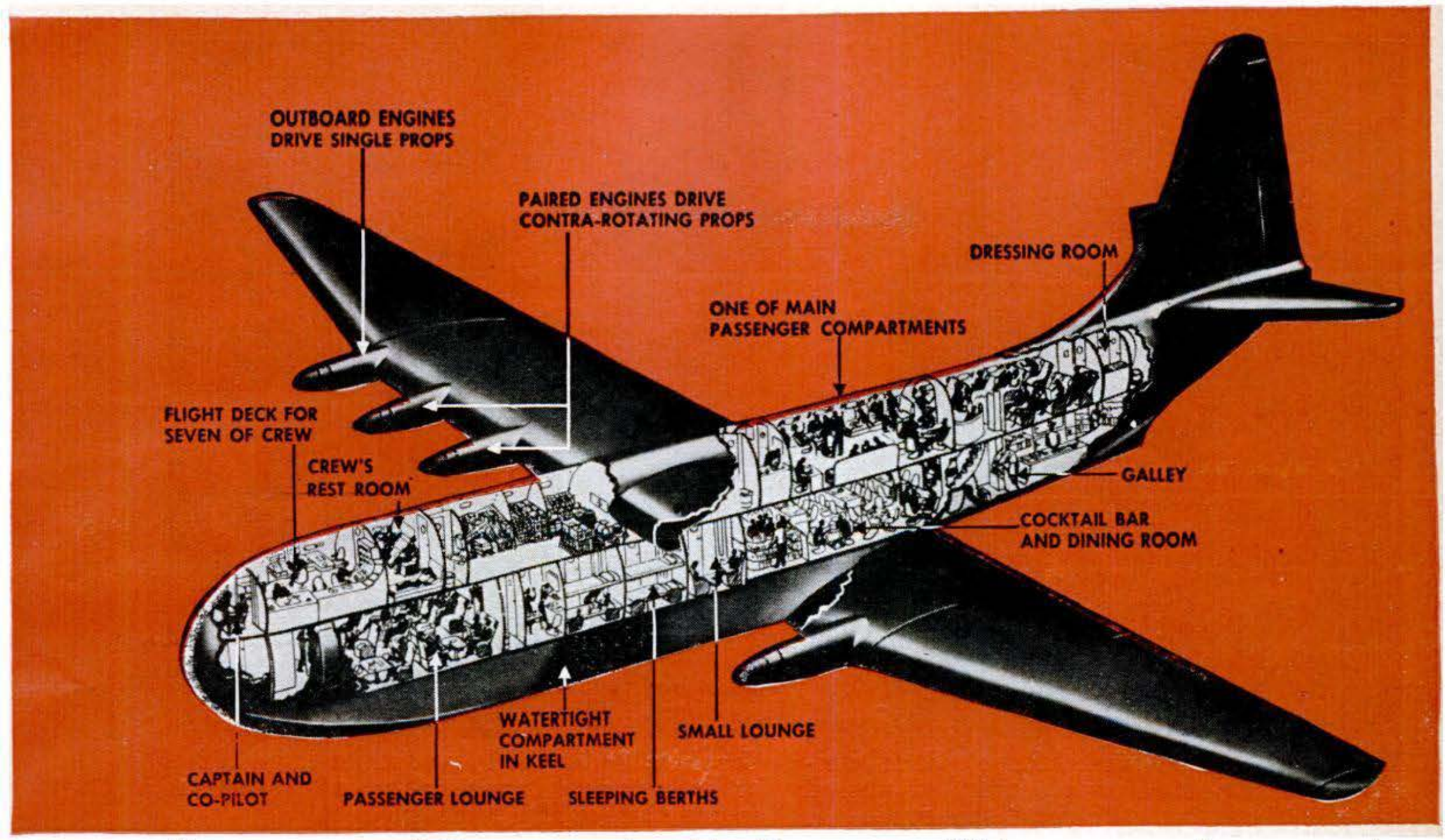
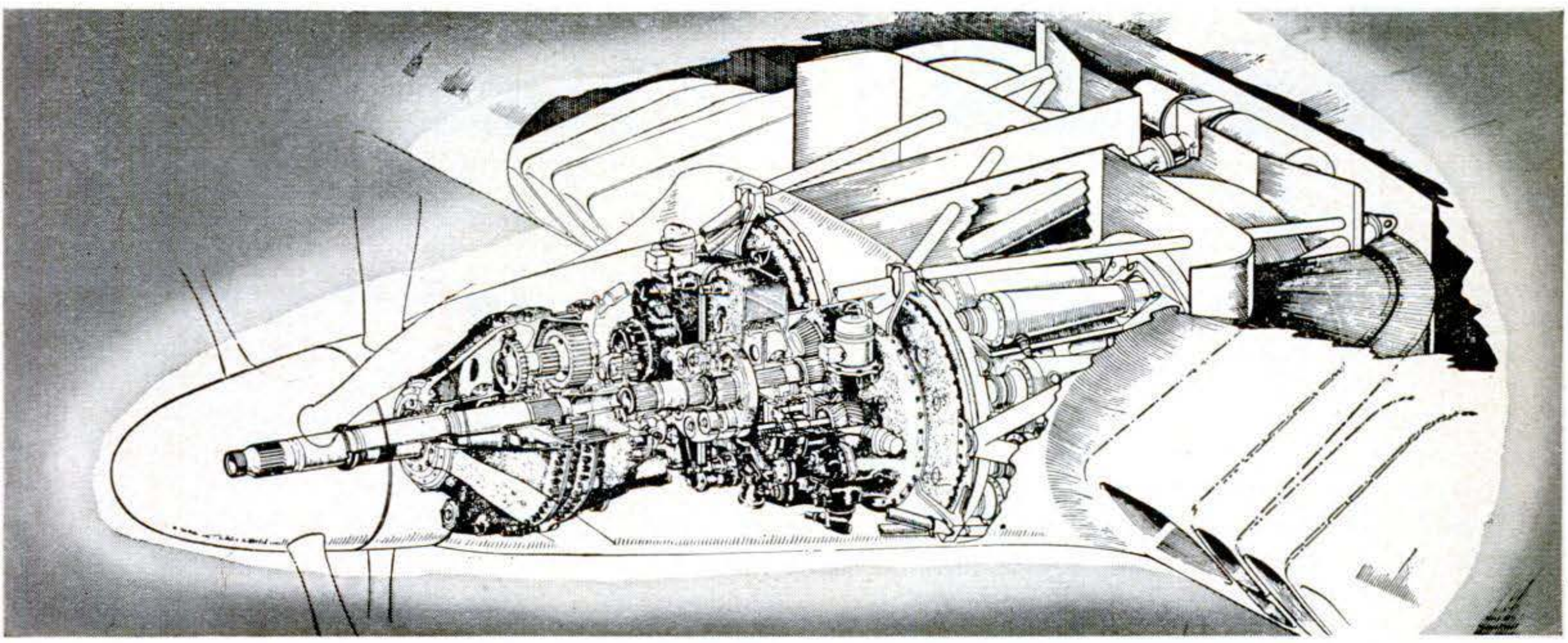


Luxury accommodations are previewed in this cutaway of Princess, now under construction.

propellers, with a total of some 35,000 hp. Eight of the engines are in pairs, each pair driving a pair of contra-rotating propellers; two single engines and props are in outboard positions. The plane will cruise at 380 m.p.h., and will have a still-air range of 5,500 miles. Even at that extreme range, the payload will be between 20,000 and 22,000 pounds. In case of a forced landing, watertight compartments will give buoyancy.

Capable of flying at 40,000 feet, the plane will maintain cabin pressure equal to that at 8,000 feet. Three of the big flying boats are under construction, at a total cost of about $20,000,000. The first of the Princesses is expected to fly early in 1951. END



Sectional drawing above illustrates how two Bristol Proteus turboprop engines are coupled to drive the SR/45's contra-rotating propellers. There will be four of these double engine jobs in the inner wing positions, with two single engines in outer positions. The 10 engines will develop a total of about 35,000 hp. and give the Princess a cruising speed of 380 m.p.h.

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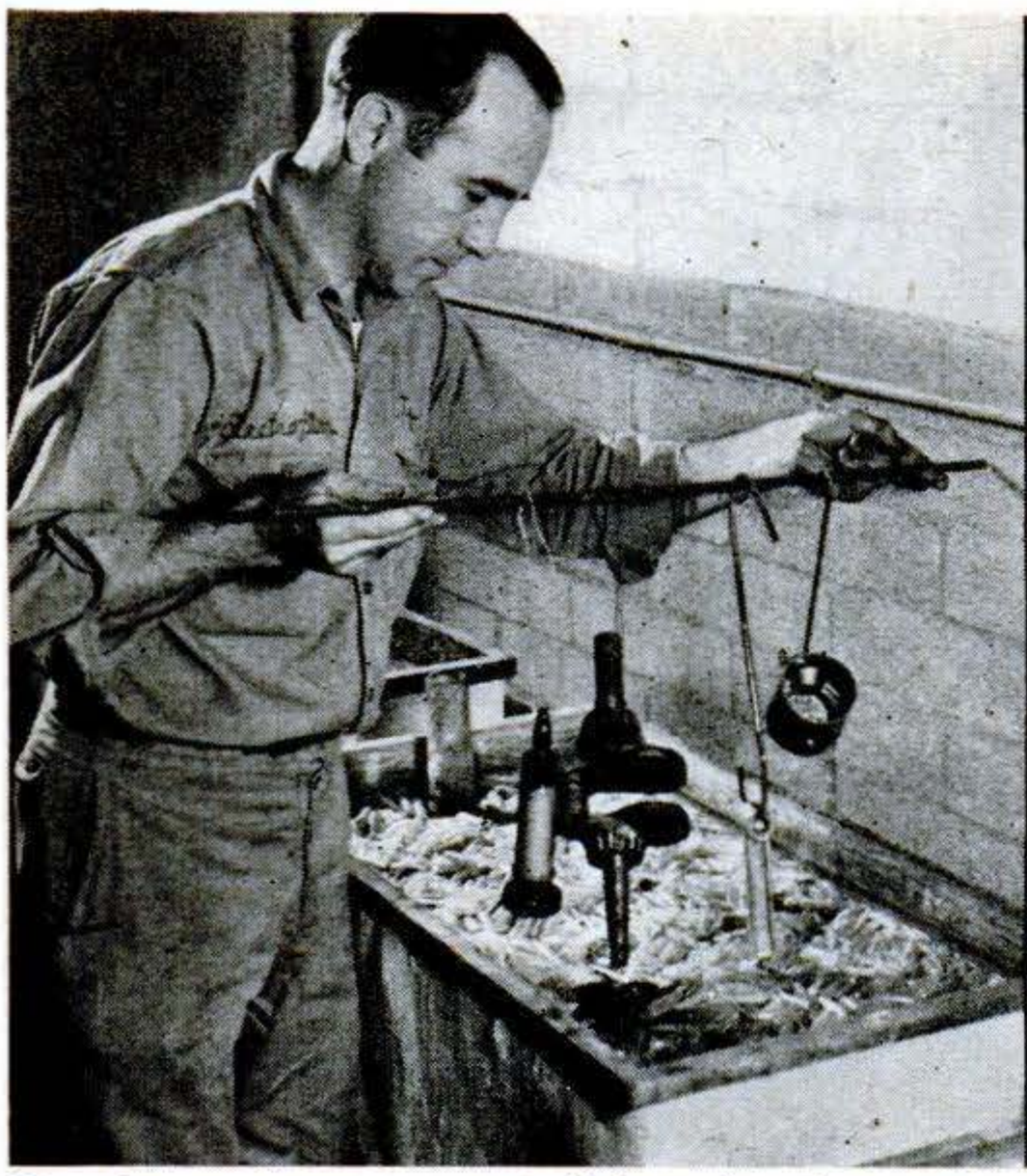
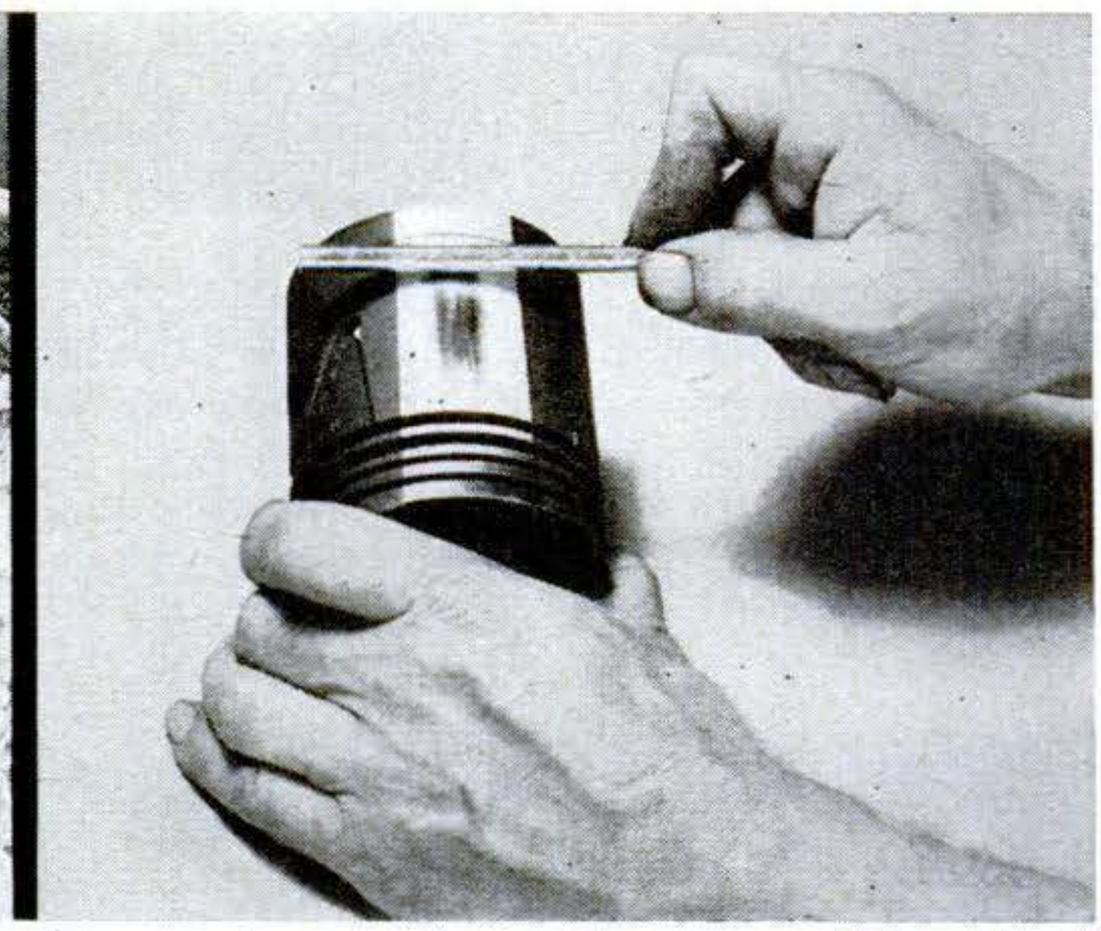


Metals are rustproofed (above), after careful cleaning, for "graphitizing." Standard treatments—varying with metal—are used.

Graphite is applied by spraying, as above, or by dipping. It penetrates surface, as well as providing a film .0005 in. thick.

Coated parts then are baked for 40 minutes at 400°F. This treatment sets the coating, preventing chafing or moisture penetration.



Even after surface film is sandblasted off (white area above), rubbing brings up new film of lubricating graphite (black streak).

Lubricant Baked into Engine Parts

A NEW way to impregnate metals with graphite may prolong the life of your car and other machinery, too.

Graphite, the slippery black form of the element carbon, is most commonly seen as the "lead" in lead pencils. It is also an excellent lubricant, widely used on door hinges and the like. However, it quickly wears away from points of high friction.

Now two chemist-brothers of North Hollywood, Calif., Ralph and Edwin Hall, have found a way to get around that disadvantage. They force the graphite into the "pores" of metal, plastic, or synthetic-rubber surfaces, so that the supply under the surface will constantly renew a .0005-inch film on the surface, no matter how hard the wear.

The Halls' firm, Electrofilm, Inc., has successfully applied the "graphitizing" process, outlined in photos above, to auto engine parts, gun mechanisms, tools, tractors, electrical apparatus, and other machinery.

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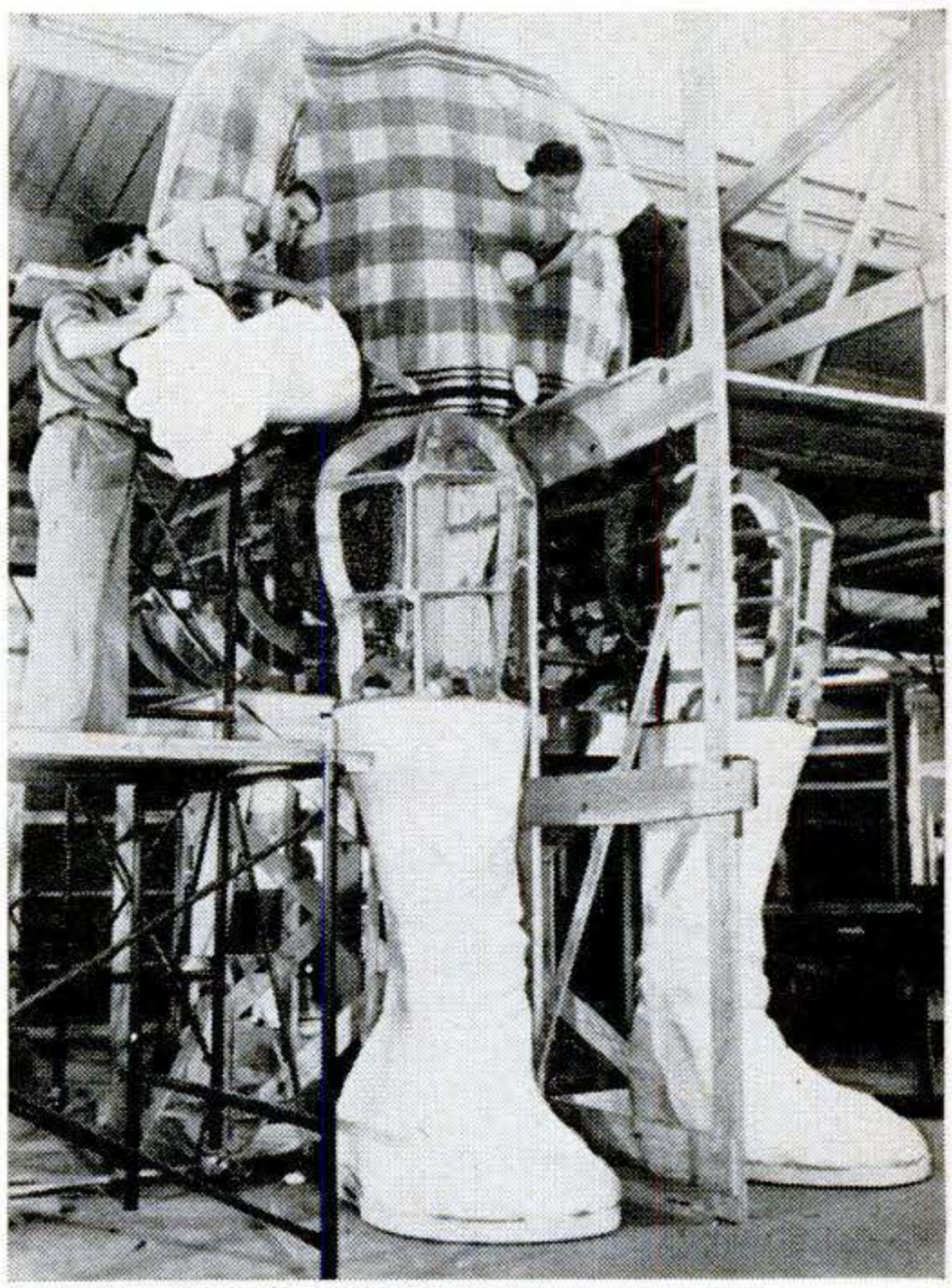
Girl sitting on model's knee gives an idea of its size. The figure talks, rolls its eyes, and moves its head and arms. Buttons are big as pie plates; shirt would make 80 blankets.

Paul's moustache gets a final touch-up from artist's brush before the head is hoisted into place. The model's makers call it the largest animated figure anyone has ever built.

Paul Bunyan Comes to Life

VISITORS to the 1949 Railroad Fair in Chicago can have a heart-to-heart chat with Paul Bunyan, legendary super-lumberjack of the North Woods. A complex array of microphones, sound-recorders, speakers, electric motors, and gears enables the giant figure to talk with passers-by and answer their questions. Sitting down, Paul towers 23 feet above the floor. If he stood up he'd stretch 35 feet. He wears size 69 boots, a 42 cap, size 80 shirt, and pants with a 150-inch waist. The Gardner Displays Co. built the gigantic model for the Chicago and Great Northern Railway exhibit.



This view of the half-completed figure shows the details of its structural-steel skeleton. The feet are 4 feet, 9 inches from toe to heel; boot caulks are big as railroad spikes.

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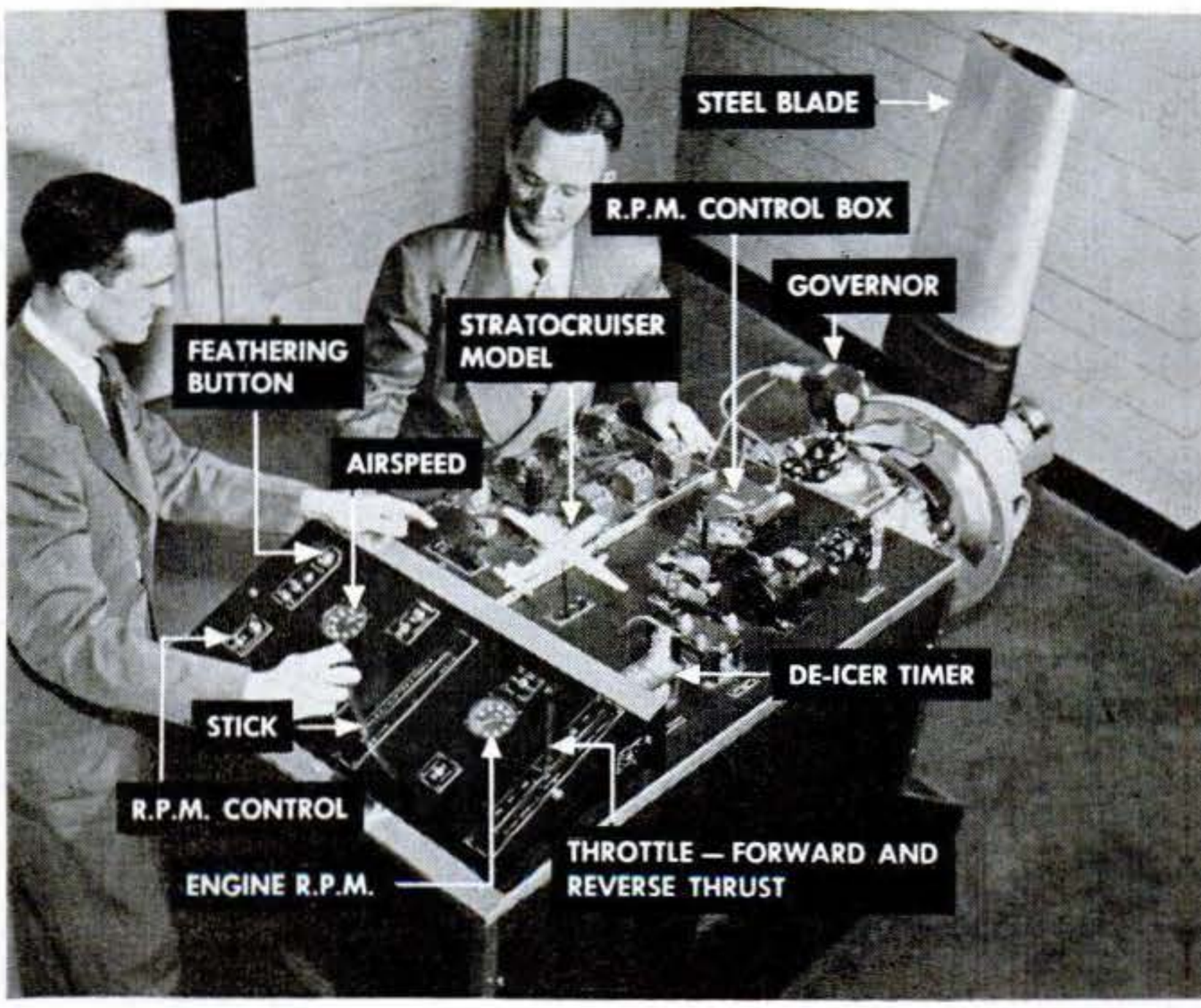
What's New in Aviation

Jet Fights at Night. The revamped and elongated nose of this version of the famous Lockheed F-80 Shooting Star is packed with radar, enabling it to fly and fight in pitch darkness and under all weather conditions. Designated the F-94, it is the Air Force's first jet night fighter, built for high-altitude interception of possible enemy attackers. An afterburner gives emergency boost to the power of the J-33 jet engine. The new plane is flown by a two-man crew —a pilot and a radar operator.

Connie's Humps Test Gear. New electronic devices are being tested in a pair of radomes (arrows) projecting from the top and belly of the Lockheed Constellation® below. Called the PO1-W, the plane also has a slightly elongated nose and carries a row of spinelike antennas along the top of the fuselage. Electronic systems proved successful in this experimental Navy project will be produced for use in transport and military types of airplanes.

Hangar-Flying Machine. These engineers are flying a Stratocruiser® without taking their feet off the ground. The instruments on the panel below simulate operation of the Hydromatic® propeller and control system used on the Boeing plane. Built by Hamilton Standard, the machine lets pilots and mechanics watch the propeller system work as it does in actual flight. The demonstrator can imitate constant-speed operation, reversing, feathering, and de-icing.



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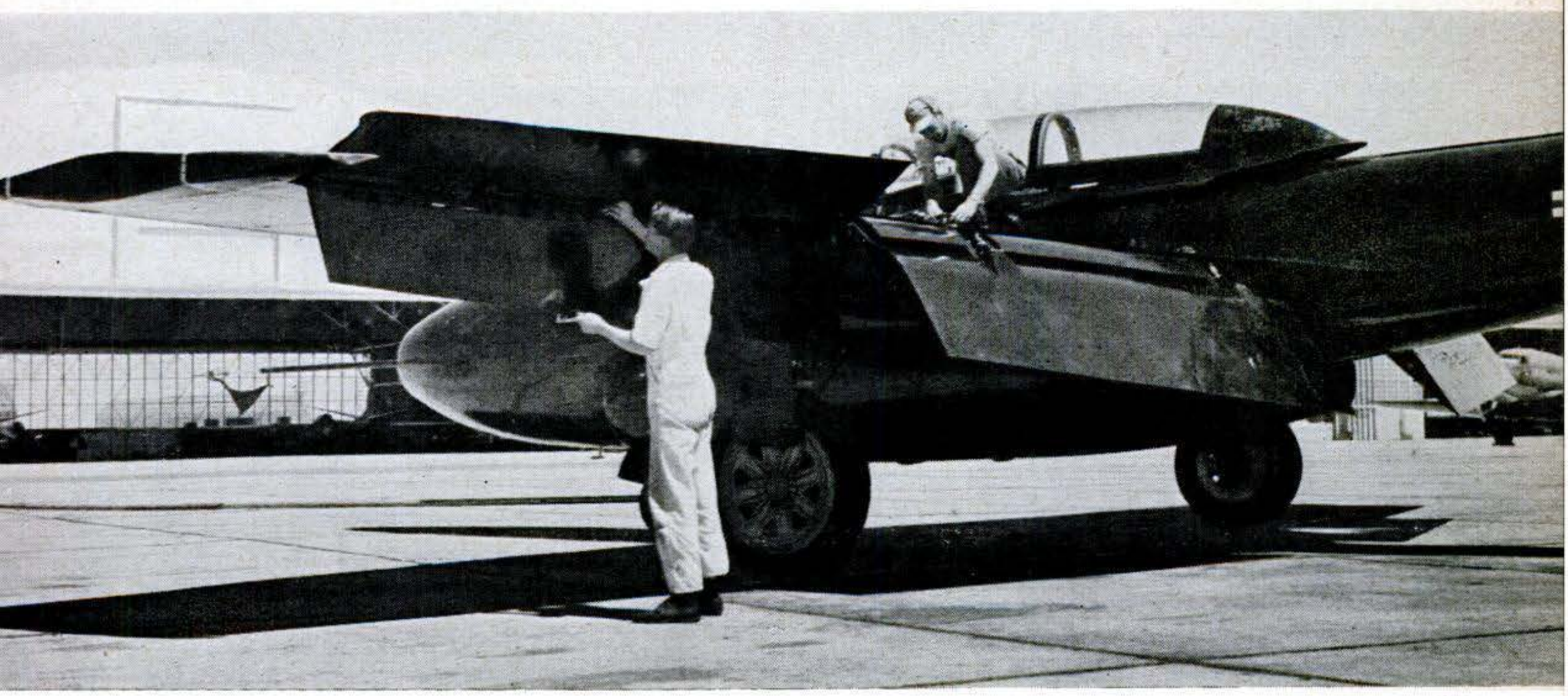
Thunderjet's New Schnozzle. Needing a "radar nose" (like the one shown on the F-94 at left) for night and bad-weather interception, the F-84 Thunderjet also has undergone a face lifting. The job was done by eliminating the conventional nose air intake, shown at right, and substituting flush, side inlet ducts as shown above. The experimental plane is a result of collaboration by Republic Aviation and National Advisory Committee on Aeronautics.

Big Flaps Aid Jet Flight. Jawlike control surfaces on the Northrop Scorpion's wings (below) serve a triple purpose. Moved in opposite directions, they become ailerons. Opened like jaws, they slow down the aircraft in maneuvering, permitting it to make steep dives with safety. And when the lower surfaces are depressed simultaneously, they slow the F-89 for landings. Called "decelerons," the surfaces also help the Air Force fighter carry a heavier load, while giving it greater maneuverability.



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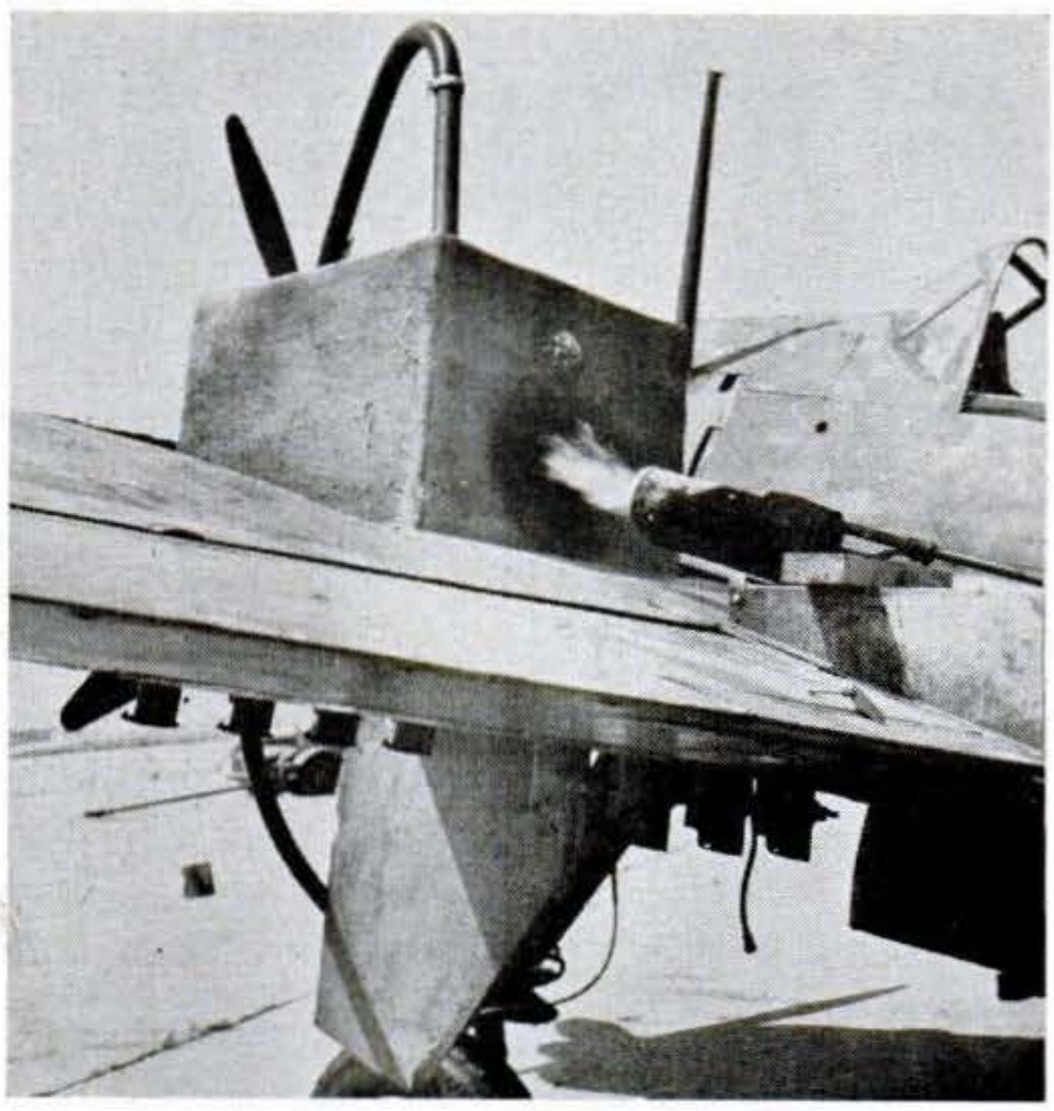
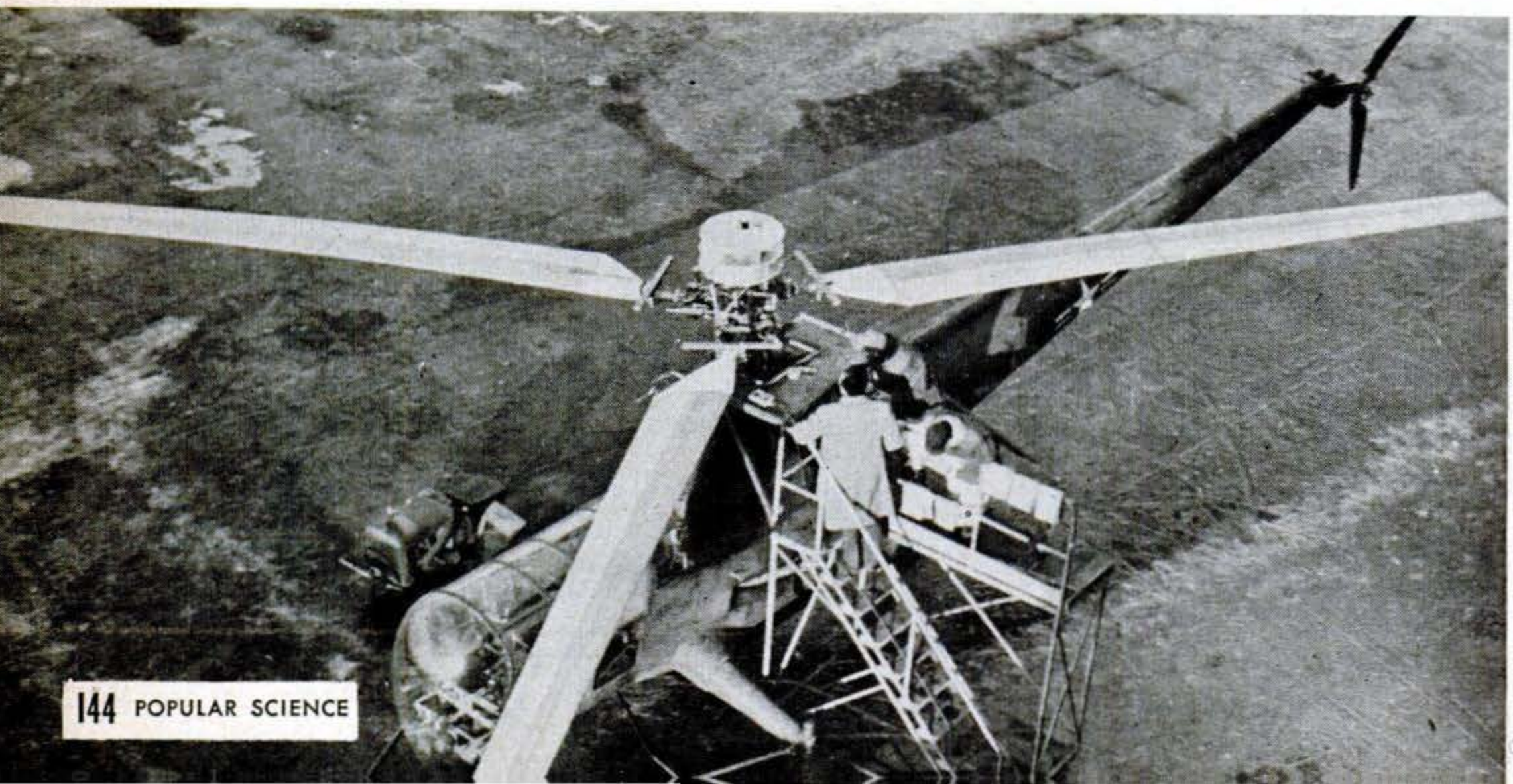
High Performance at Low Cost. Twin-tailed and reminiscent of the famous Beech Bonanza®, this Jupiter® is made by the Jamieson Aircraft Co., of Deland, Florida, to sell for $2,500. A Lycoming 115-hp. engine gives the plane a 150-m.p.h. cruising speed, claim the designers. It is a three-placer, with retractable tricycle landing gear. Other claims are that it will land under 40 m.p.h., take the air in 100 ft.

Jet Lands on Rubber Deck. This British de Havilland Sea Vampire single-engine, jet naval fighter, with its undercarriage removed, has been used to test carrier landings on a flexible rubber surface that needs no arresting wire. Weight saved by eliminating the landing gear can be used for bombs, guns, rockets, fuel, or ammunition. Launching is by catapult. The plane is powered by a Goblin® turbojet of 3,000-lb. thrust.

Fuel Tank Resists Fire. The 2,000° F. flame of a blowtorch doesn't bother the fuel tank at right, installed in the wing of an obsolete plane for demonstration purposes. The secret is in a flexible coating of American-made rubber combined with other materials that make it fire resistant. The new protective coating was developed by the B. F. Goodrich Co.



'Copter Tries Glass Blades. There's more strength in the molded Fiberglas® blades shown on the Air Force helicopter below. Extreme smoothness and greater rigidity enable the blades to lift more weight per horsepower than many ordinary blades. The 22-foot whirlers were developed by the Cornell Aeronautical Laboratory for the Air Materiel Command.



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Jeep Tells "American Story"

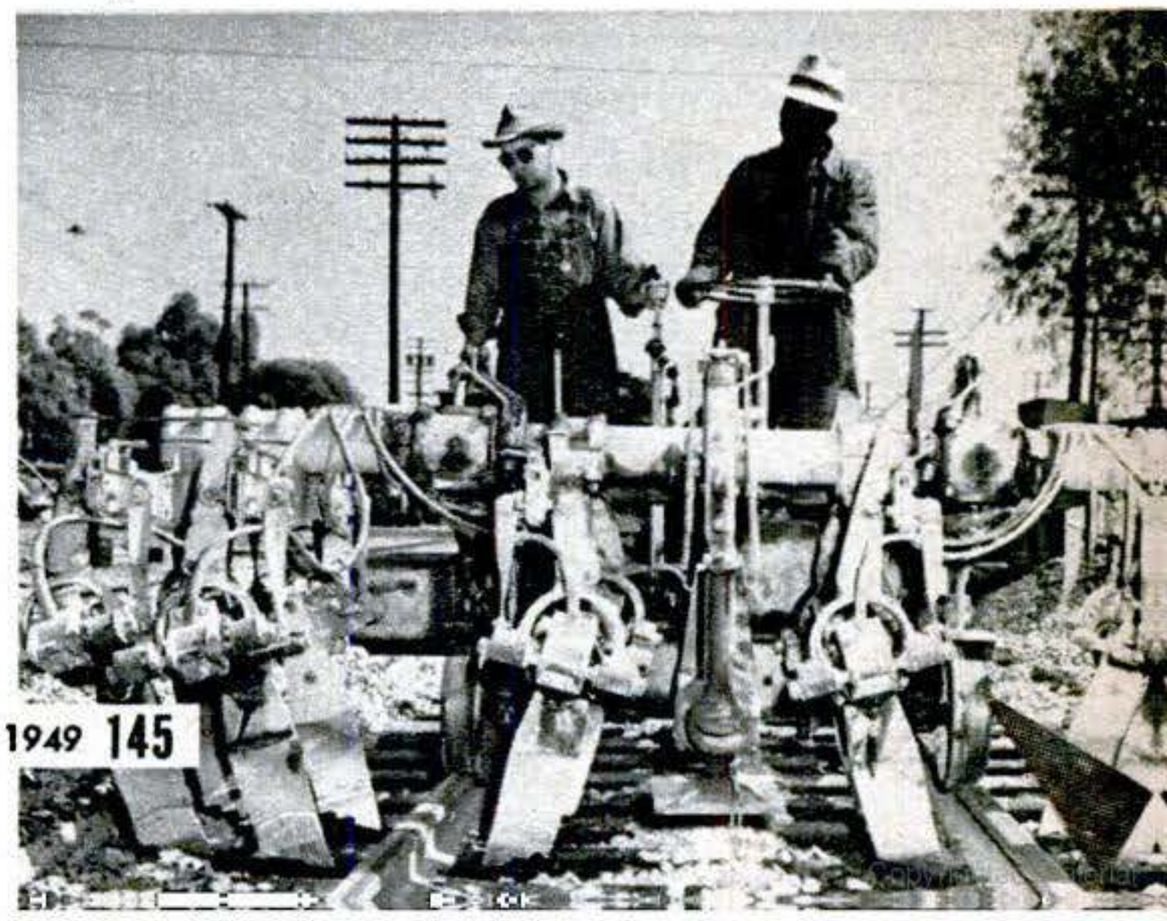
THE specially built, $4,500 jeep at right is the first of 65 that will tour the world for the U. S. State Department to help spread the "Voice of America." Power for its movie and radio equipment comes from a 3,000-watt generator. Long cables permit indoor movies to be shown in villages lacking electricity. A short-wave receiver will bring "Voice" broadcasts to remote, radioless areas. The jeep's 80-gallon gas tank and large food and water supply can keep it on the road for long periods.

Surgery Televised in Color

THROUGH the television camera pictured here, hundreds of doctors at this year's American Medical Association convention saw full-color close-ups of surgical operations. The telecast, by wire, requires only two TV men in the operating room—one to handle the camera boom and one at a monitor screen to focus the camera and blend the colors.

Steel Fingers Tamp Roadbeds

THE 12 steel fingers on this small handcar take the place of a dozen workmen in tamping ballast under railroad ties. One man operates the hydraulic tampers while another moves the car from tie to tie with a large handwheel geared to the wheels. Now in use on Santa Fe lines, the Jackson Multiple Tamper® can ballast five ties a minute.



Radio Beams Flag Planes

Fastest planes clocked by electronic equipment that can tick off flying time between exactly spaced radio "walls."

By Herbert Johansen

Drawings by Ray Pioch

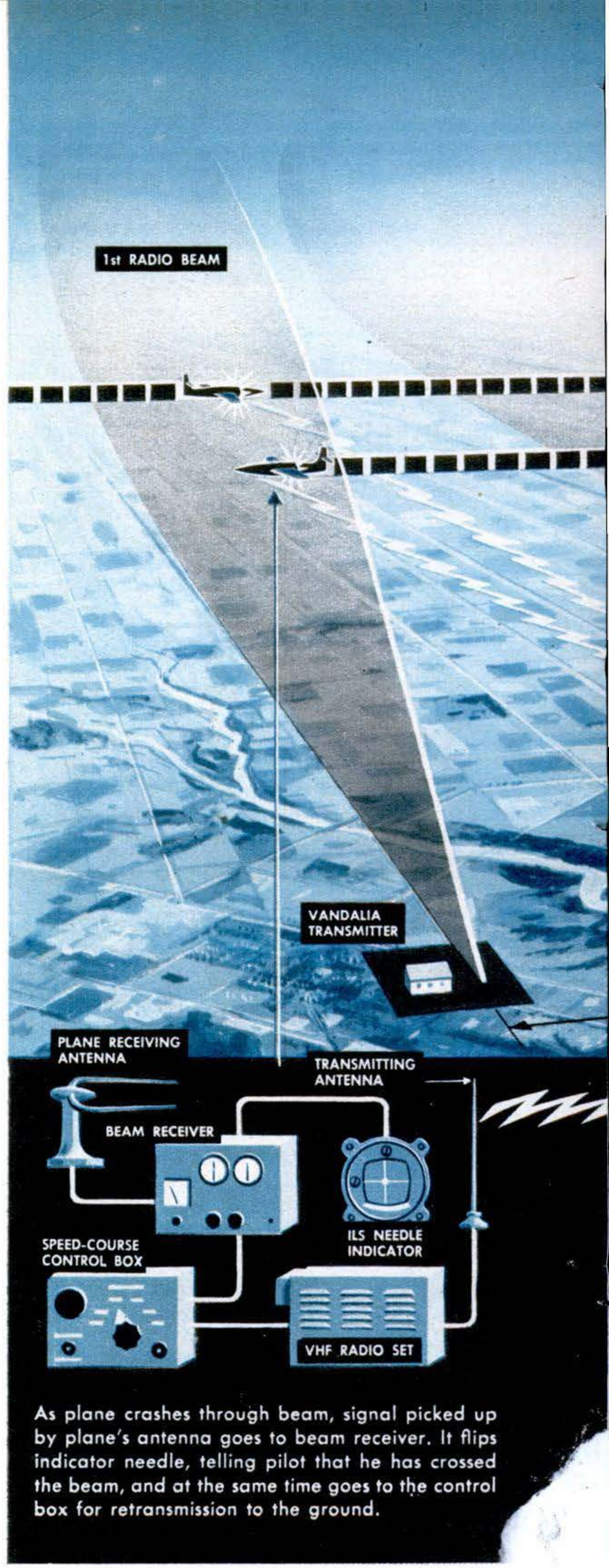
STREAKING between two parallel radio beams that flare into space 11 miles apart, Air Force speedsters can now be timed automatically with an accuracy of 1/1,000 of a second. And they can fly as high as 30,000 feet while making their speed runs.

The ballistic cameras previously used for timing (PS, Sept. '47, p. 150) forced planes to make their passes at extremely low altitudes if they were to keep in the picture. Now, with the new all-altitude speed course developed by the Air Materiel Command at Wright-Patterson Air Force Base, Dayton, O., not only is accuracy increased, but the sky's the limit.

The two vertical radio beams—which act like electronic versions of the start and finish flags used in auto races—are provided by very-high-frequency transmitters on the ground. One is located at Patterson Field and the other at Vandalia, exactly 11.0533 miles apart. The trick is to make these beams like sheets, or walls—very wide vertically yet very narrow (about two degrees) horizontally. This is just the opposite of ordinary broadcasting, in which radio waves are scattered all around horizontally.

At Sulphur Grove, about halfway between, is a third station. It houses receiving equipment and a chronograph unit that records the actual timing on a moving tape. It also has a transmitter to send out a third beam, providing a shorter course for slower aircraft and a check point for the entire course.

The aircraft also carries special radio receiving and transmitting equipment. The instant the plane passes through a beam, this



As plane crashes through beam, signal picked up by plane's antenna goes to beam receiver. It flips indicator needle, telling pilot that he has crossed the beam, and at the same time goes to the control box for retransmission to the ground.

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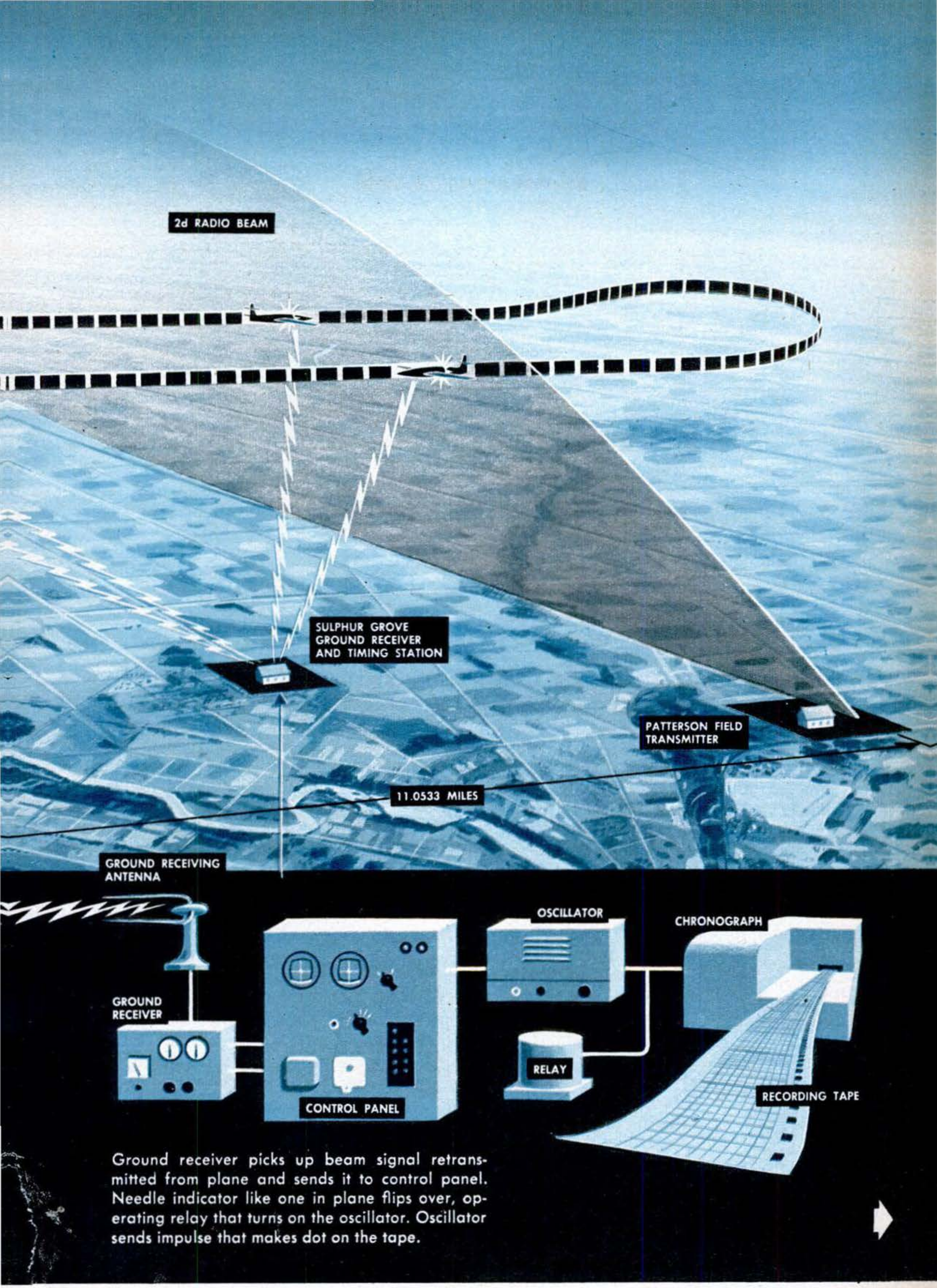

Ground receiver picks up beam signal retransmitted from plane and sends it to control panel. Needle indicator like one in plane flips over, operating relay that turns on the oscillator. Oscillator sends impulse that makes dot on the tape.

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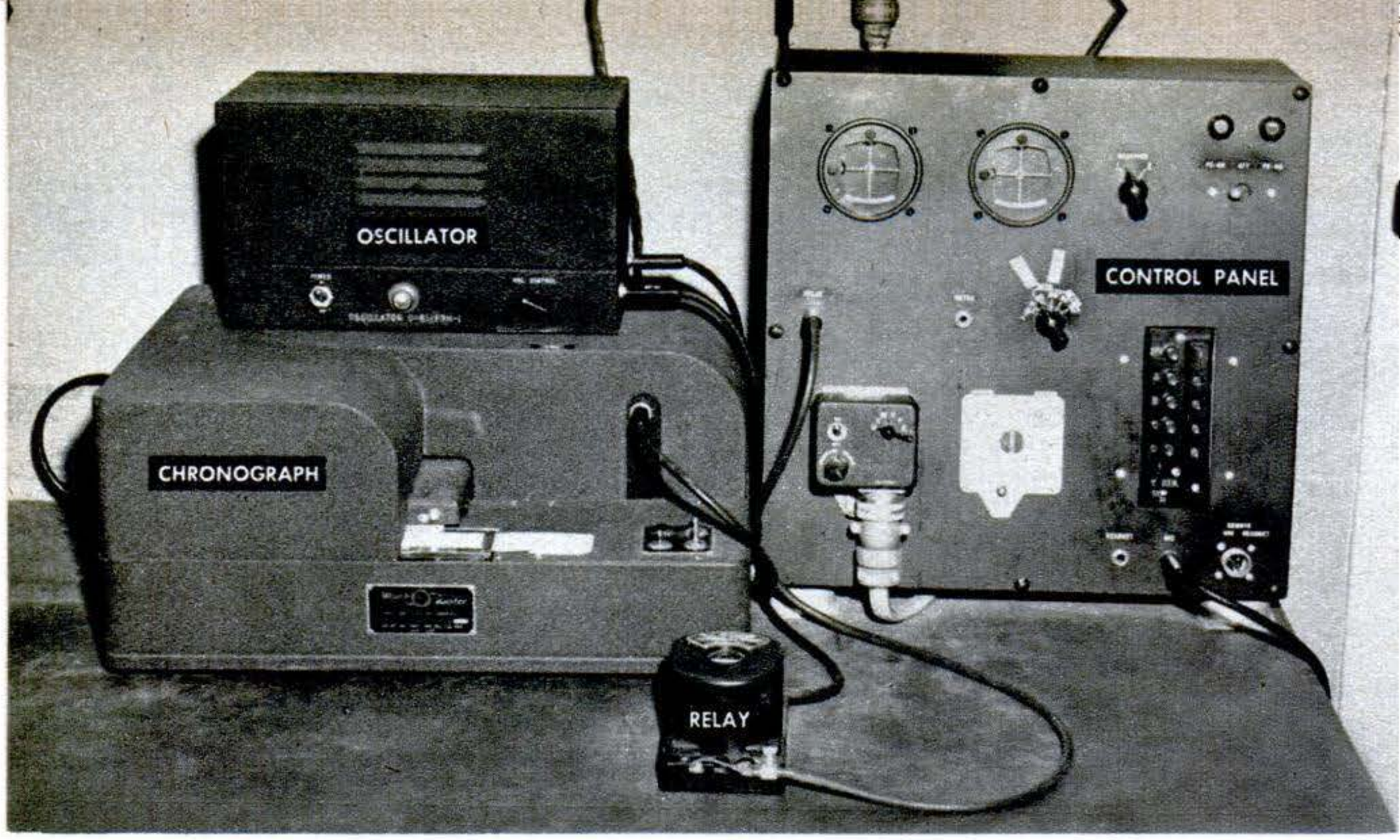
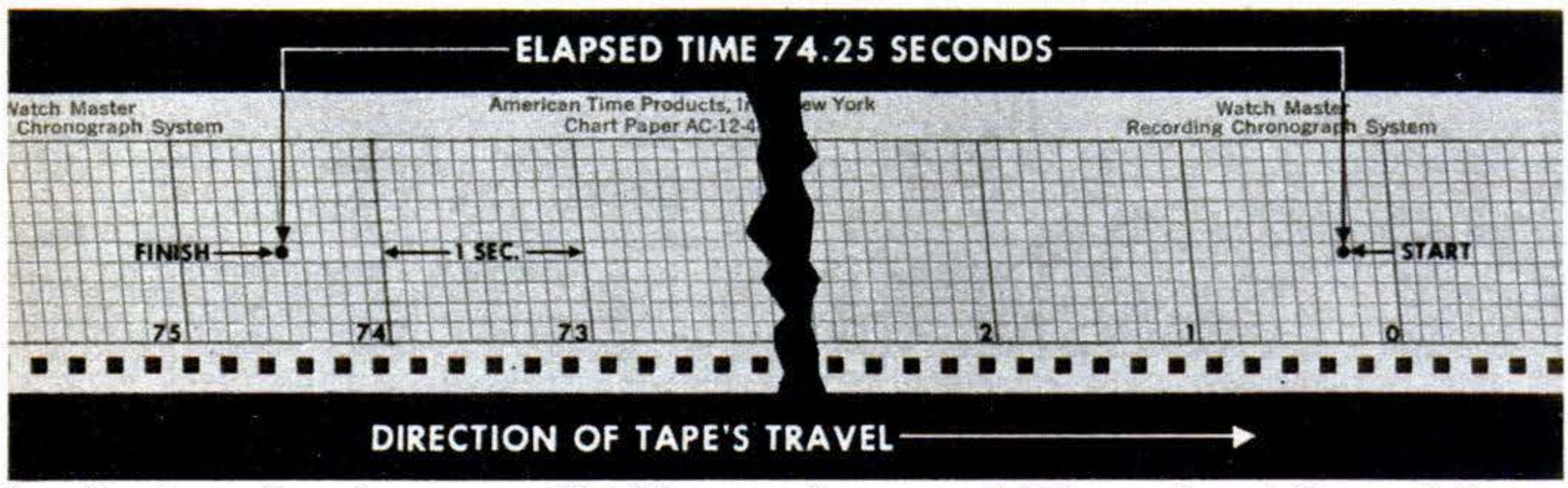


Telemetered signal from plane is interpreted on the ground and recorded by equipment above.



Sample of tape shows how start and finish beam-crossings are recorded on tape running through the chronograph. Since elapsed time between beams was 74.25 seconds, and distance is known to be 11.0533 miles, ground speed of plane in this test run was approximately 535 m.p.h.

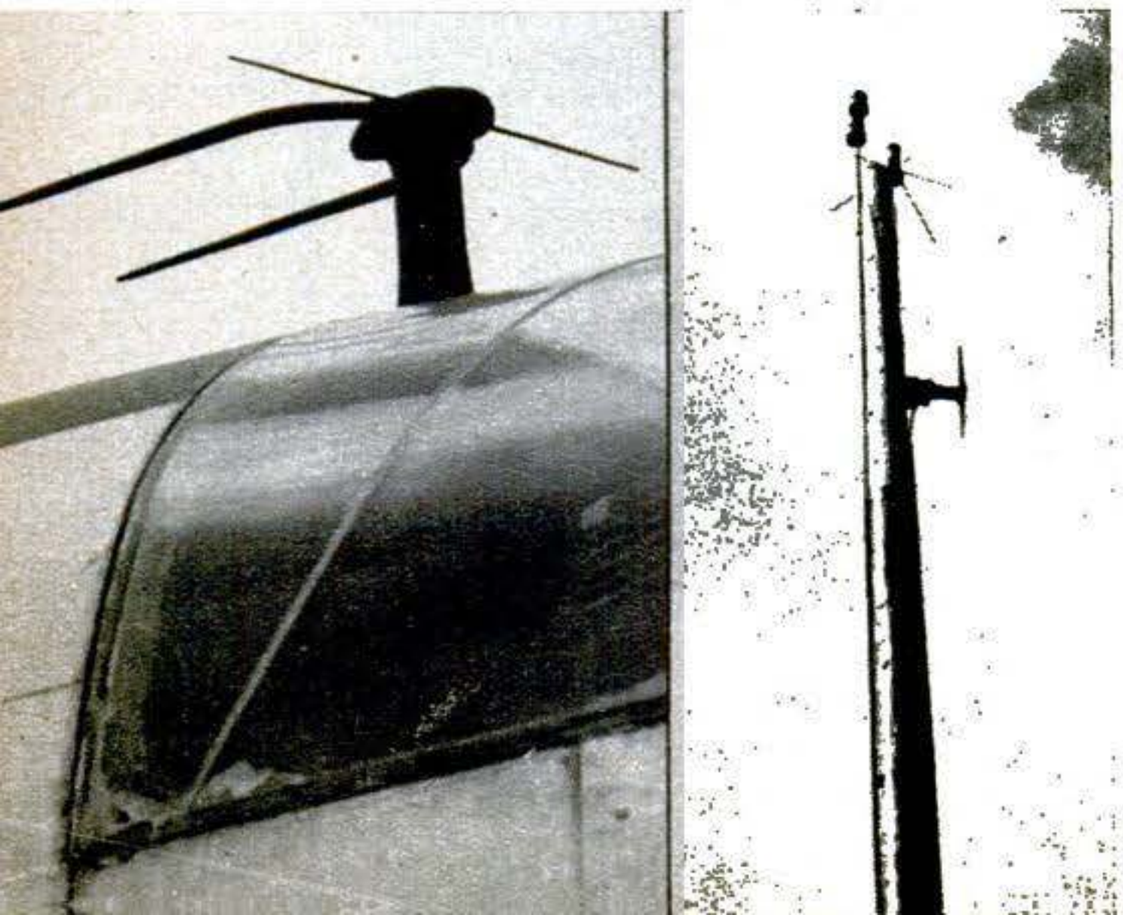
equipment signals the ground receiving station. The signal triggers the chronograph.

In making a speed run, the pilot calls the ground timing station on voice radio to announce that he is approaching the first beam. The tape is started running through the chronograph. As he "crashes" through the beam, the beam signal picked up by his receiver flips the needle on an Instrument-Landing-System indicator, telling him that he has crossed the first beam. He then switches to the channel frequency of the second beam. At the same time, the beam signal he has received is automatically retransmitted to the central ground station.

Picked up by the ground receiver, the retransmitted signal causes an oscillator to feed an impulse into the chronograph, marking on the tape the exact instant the beam was crossed. The tape continues to run until the plane crosses the second beam, when a similar chain of events occurs.

While the marked portion of the tape is removed and labeled, the ground personnel stand by for the pilot to announce that he is ready to make a second run. Two passes are made, one in each direction, to compensate for wind velocities. END

Beam-receiver antenna on plane is shown at left below. At right is close-up of antenna pole at Sulphur Grove. Antenna for transmitter is on top, and that for receiver and timer below.



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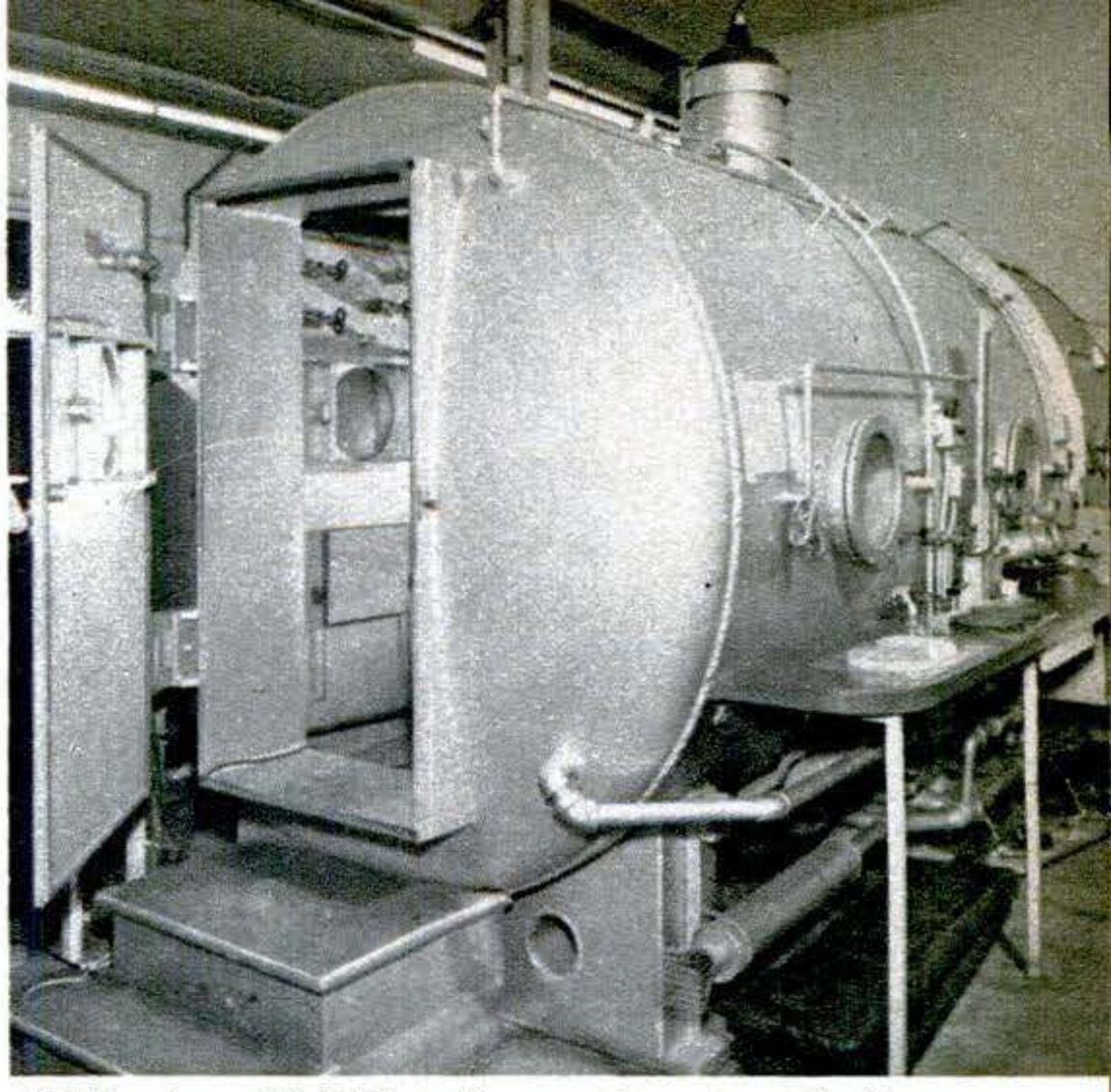
Lets In Sound Without Drafts

EVER have a hard time making yourself heard through a receptionist's glass enclosure? Well, you won't in the POPULAR SCIENCE office. A special frame built into the window (above) lets our receptionist hear a visitor speak in a normal tone, yet prevents drafts and germs from reaching her.

Invented in France by M. Jolfre, the unit consists of cellophane stretched between two plastic plates. Sound passing through holes in the outside plate vibrates the cellophane and is transmitted through holes in the inside plate to the receptionist. The Hygiaphone® has also been installed in booths at railroad and subway stations.



"Flying" Kitchen Tests Cakes

Now they're checking out cakes in this old Air Force high-altitude chamber. Home economists of Pillsbury Mills, Inc., Minneapolis, used it to test prepared cake mixes. A recipe that produces a perfectly baked cake in sea-level New York may give a leaden "failure" in mile-high Denver, for example, because of the change in atmospheric pressure.

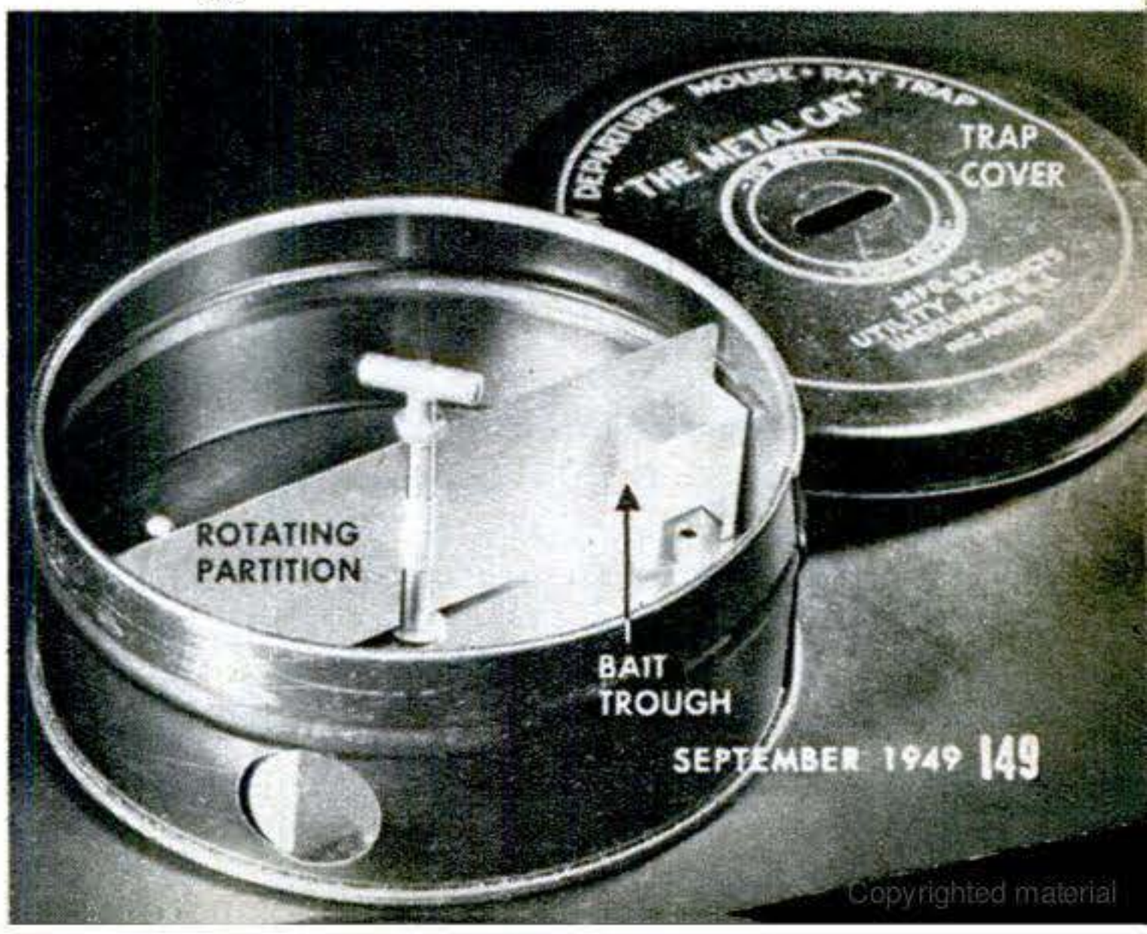
To determine the correct recipe for a particular low-pressure community, a cake was baked in the "flying" kitchen, inside which a town's air pressure had been duplicated. During recent experiments, 200 cakes were baked in 64 logged "flights." Technicians in the chamber used a phone to talk to "ground."

Cabinet Top Resists Heat

EVEN the accidental spilling of hot salad oil (as below) won't mar the new, heat-resistant, plastic work surface used by Frigidaire on kitchen cabinets and electric water heaters. Called Vitalast®, the grease- and acid-resistant finish is permanently bonded to steel by a special heat and pressure process to prevent buckling, and molded in one piece to eliminate crevices that catch food particles. A wipe with a damp cloth cleans it.

Mice Trap Themselves

RESEMBLING a powder box, the container below is really a springless mousetrap. To set it, you raise a pin (barely seen at left) and move the rotating partition against a stop. This opens the door (shown partially open) at the side of the trap. When a mouse tries to remove bait at right, he pushes the partition, closing door. To dispose of catch, you dunk the trap in water. Albia Products Co., of New York City, is the distributor.



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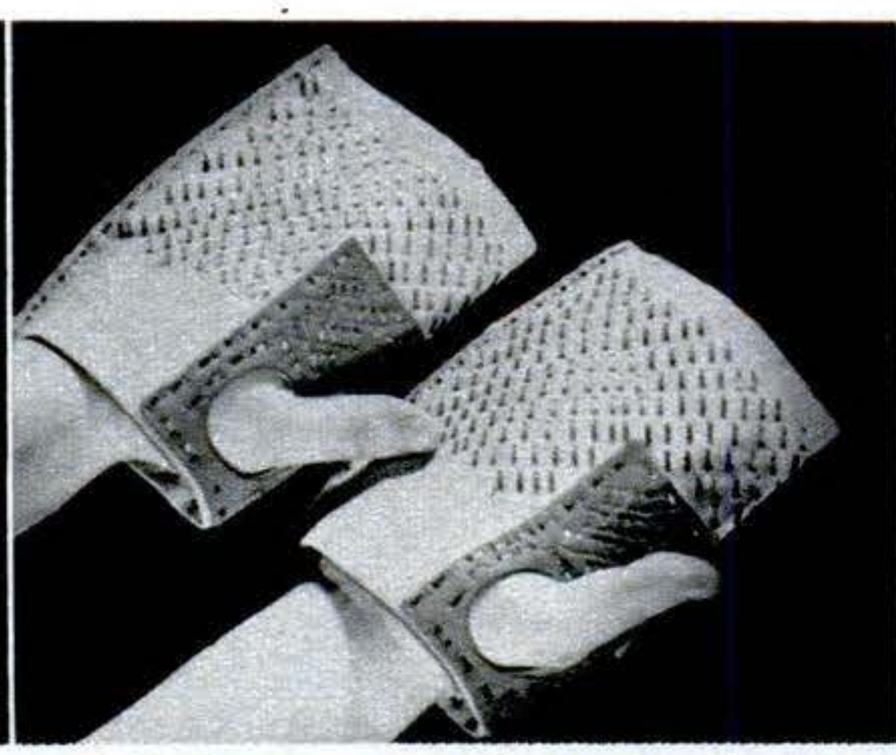
Fitting the Glove to the Job

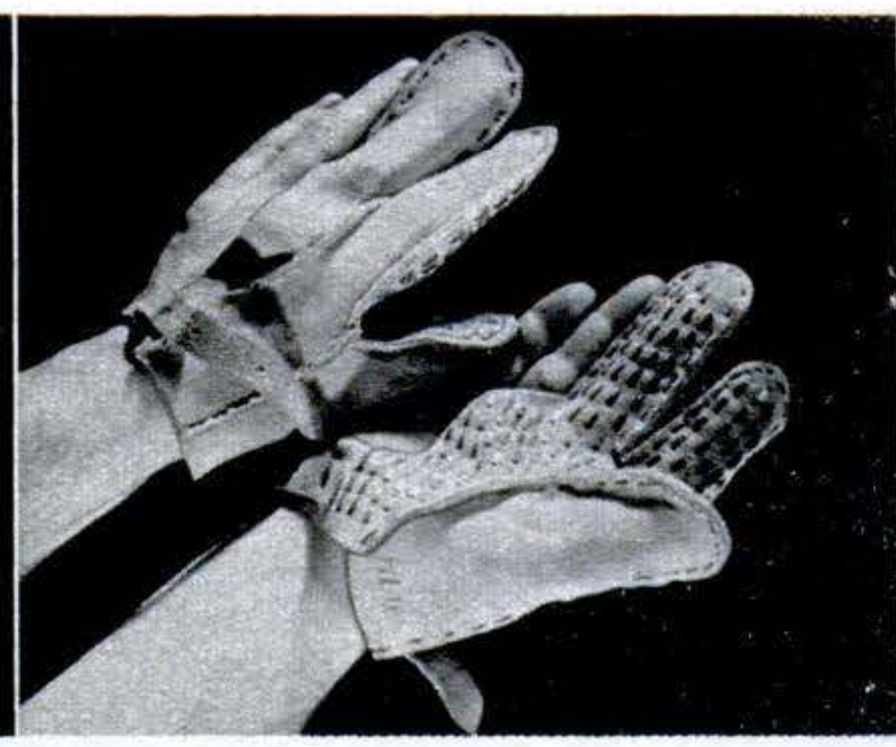
PS staff photos

THE gloves a well-dressed worker wears these days are a far cry from those white kids your best girl wore at the Junior Prom. Strictly for protection on the job, work gloves can be pretty unusual looking, as shown in this assortment. Made of leather, nylon, asbestos, and rubber, they run the gamut from a woman's flimsy nylon glove — used in the stocking industry to prevent the snagging of hosiery — to a strong, saddle-leather hand pad that safeguards handlers of sharp-edged materials and hot objects.

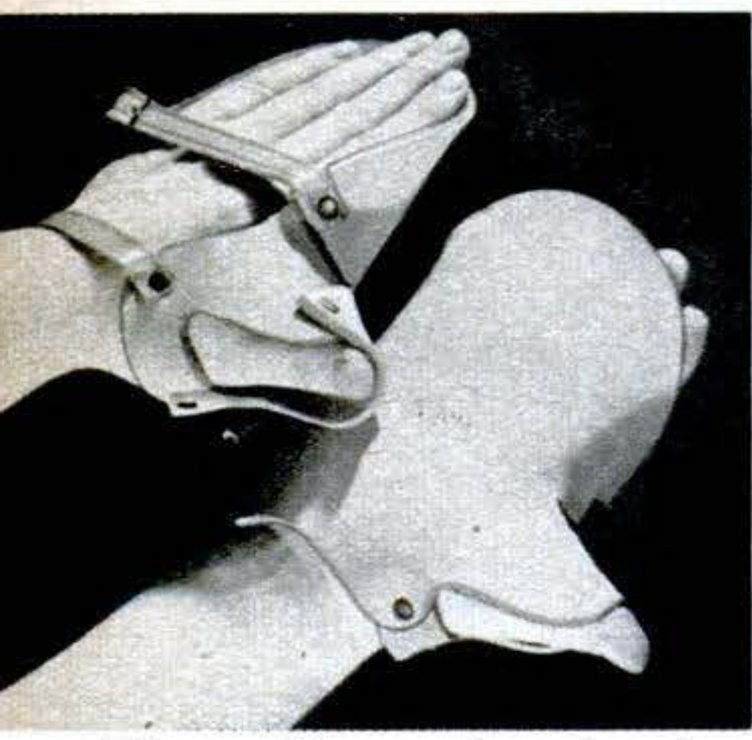
One pair of guards, third from the left in the bottom row, resembles a handball player's gloves, but actually are worn by a cable former when soldering a protective metal sleeve over spliced cable. During this operation the worker smooths the hot-solder joint with his gloved hand to form a firm bond between the end of the sleeve and the cable's outside cover.

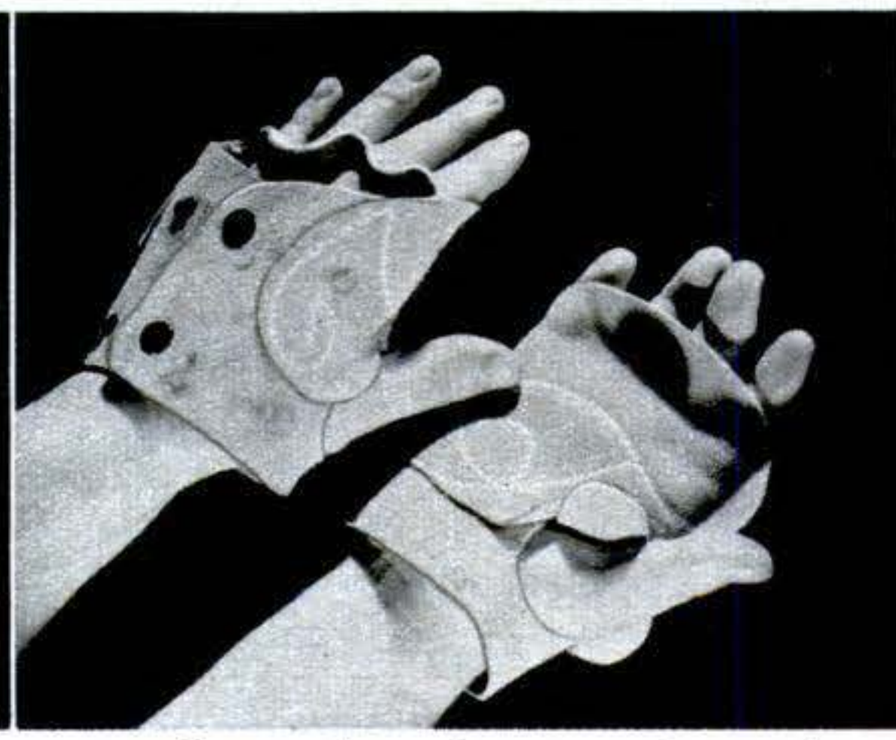
Manufactured by the Olympic Glove Co., Inc., of New York City, these hand protectors are sold in pairs or singly. Then only the worn-out glove has to be replaced. Some guards are even reversible: fit either hand.

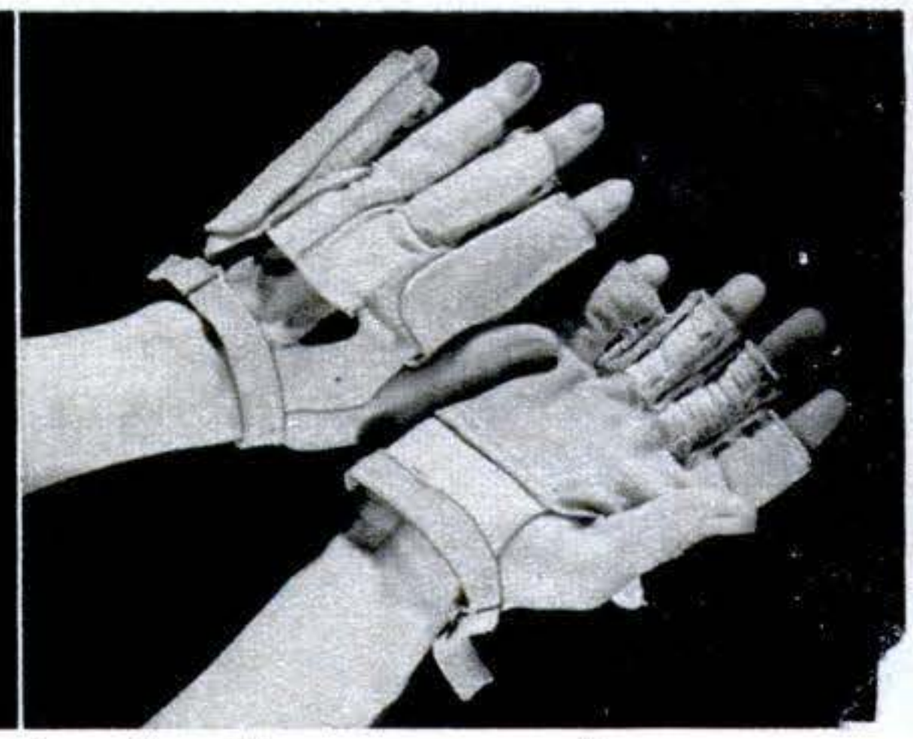




The open-end leather mittens at left above are worn by chippers—workers who scale off the rust and old paint from ships in drydock. Hand pads (center), reinforced with steel ribbons, are for manhandling steel sheets and lumber. They are reversible—will fit either hand. The steel-ribboned half gloves shown at right are worn by grinders and punch-press operators.







Worn either on bare hands or over gloves, the saddle-leather protectors at left above are for picking up sharp-edged materials or hot objects. The hand guards (center) protect bundlers using heavy twine and workers handling cartons and fiberboard. Resembling handball players' gloves, the ones without fingertips (right) are worn by cable formers during soldering operations.

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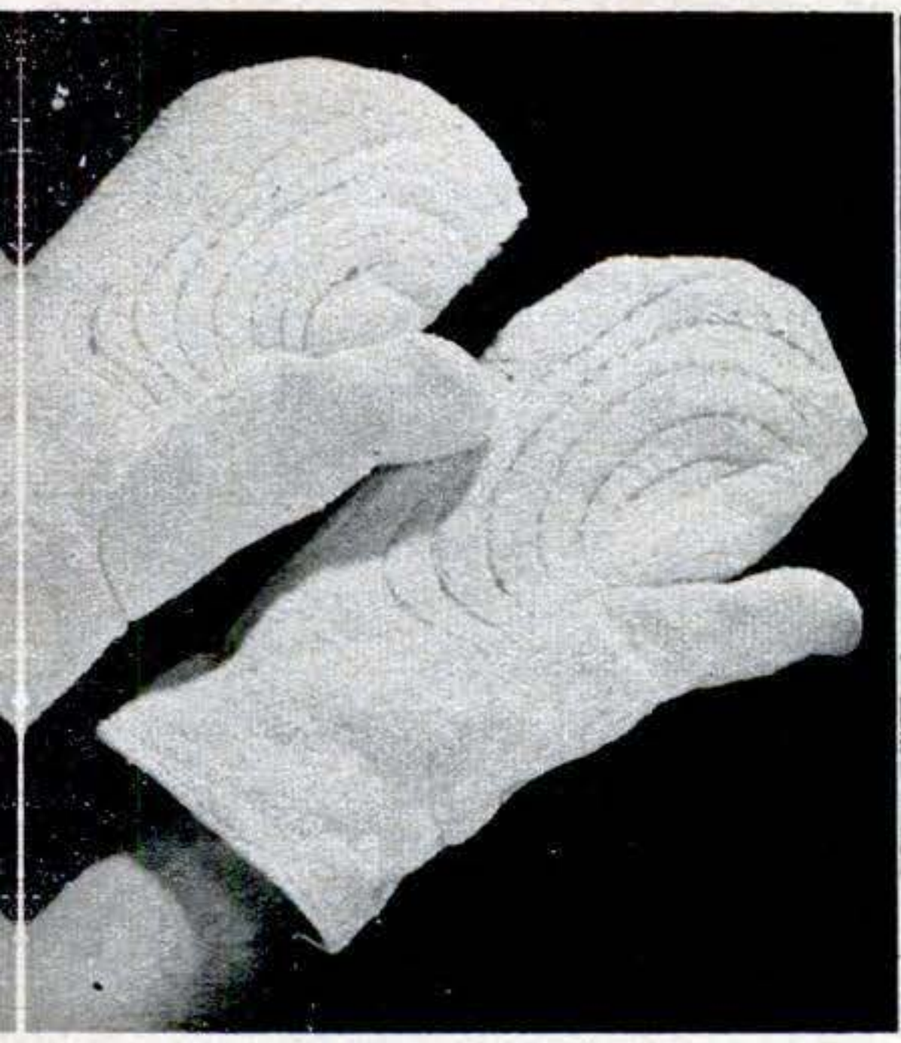
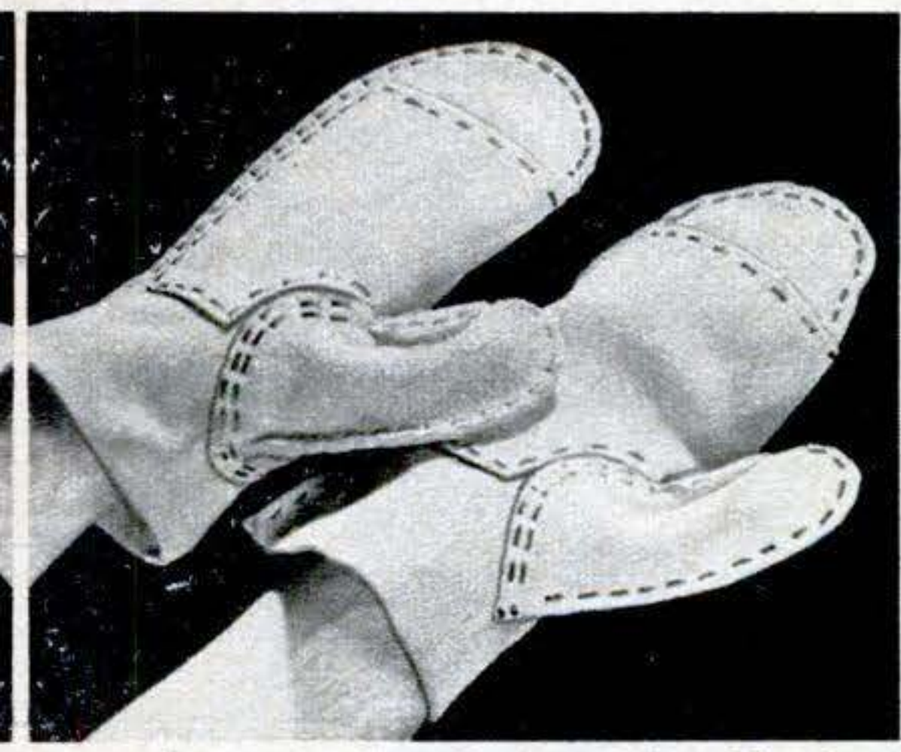
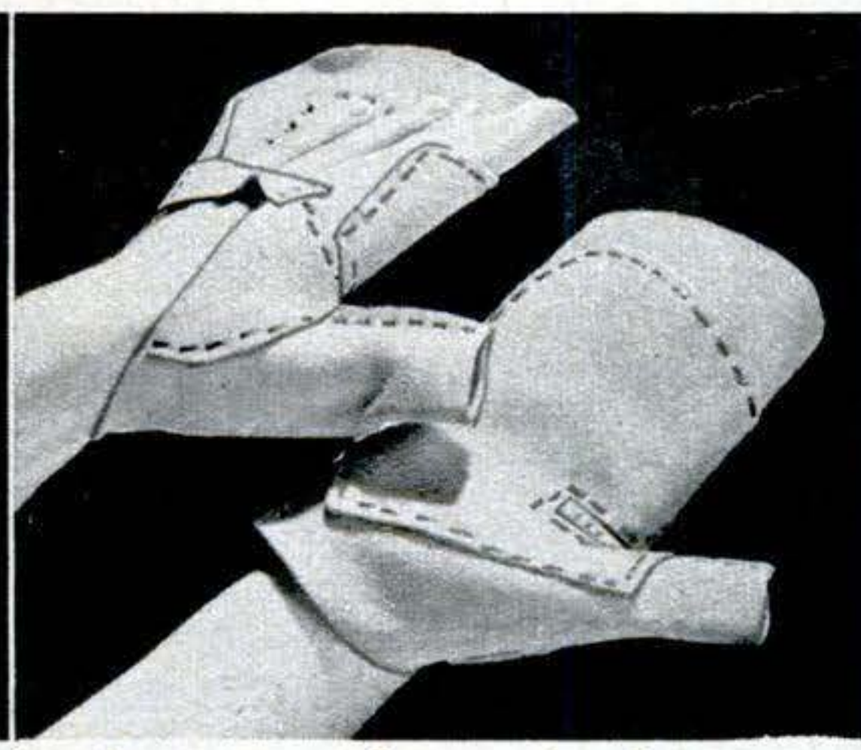
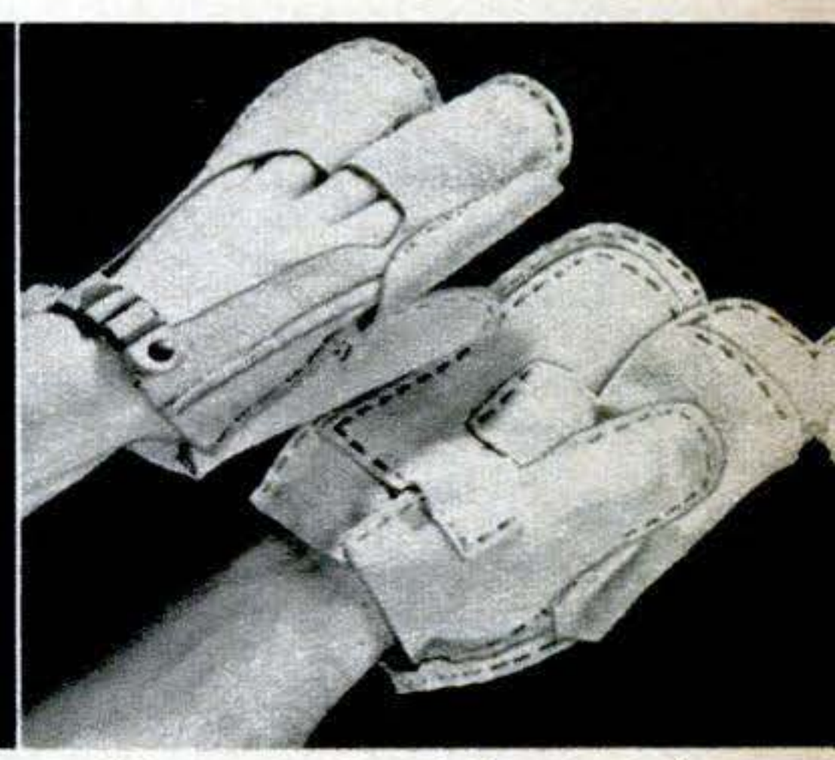


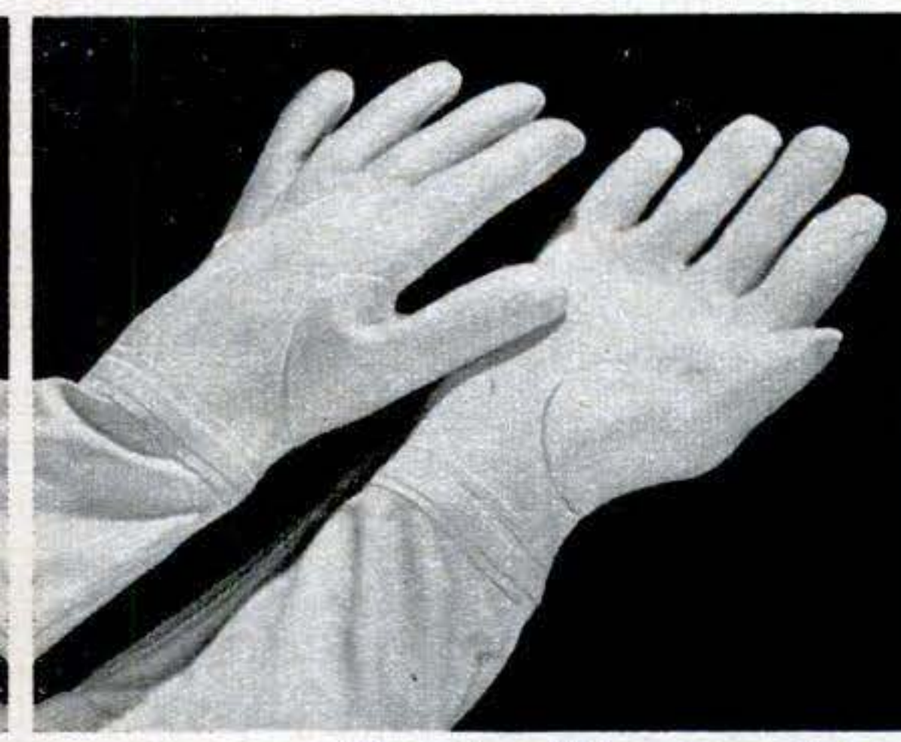
Asbestos gauntlets (above, left), quilt-stitched on the palm to lessen fraying and lined with wool felt, are for working with hot or rough materials. They are reversible, as are the two-finger mittens (center), made of asbestos and leather. In this pair the index finger has its own sheath, while the last three fingers fit into another, wider sheath. Welders wear these mittens, as well as the heavy leather gauntlets at right, which have a reinforced crotch strip between thumb and forefinger.







The three pairs of leather hand protectors above are worn for jobs that require the handling of sharp metal sheets, bars, and other rough materials. They are stitched with metal staples to take hard wear. Reversible mittens at left cover the entire hand. The guards at center have open ends and backs. The "claws" at right permit better grasping motion than mittens.



Tough-rubber gauntlets (above, left), for those who work around acid baths, protect the wrist and part of the forearm. The woman's nylon, lint-free glove at center, worn by workers in hosiery mills, is reversible. The steel-stitched, felt-and-leather arm protector at right guards workers against abrasions when they are lifting heavy objects and doing overhead work.

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Army's new transporter for household goods is shown passing one of several tests for ruggedness. Here, door holds overload thrown against it when crate is hoisted by rear shackles only.

Folding Crate Stops Thieves

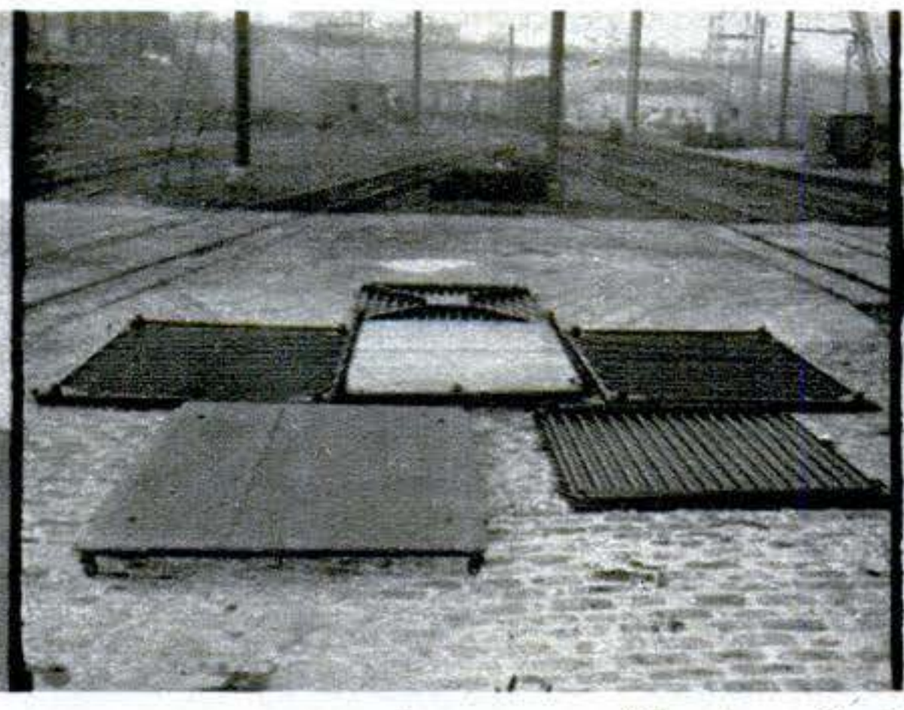
U. S. Army photos

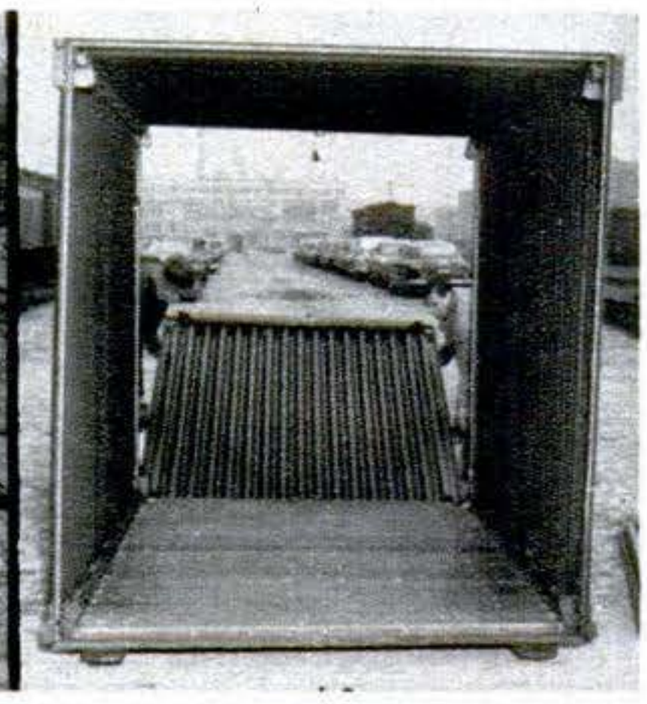
THIS collapsible metal crate, with a combination lock on its door, fills the Army's prescription for one of its most bothersome peacetime headaches: pilferage of overseas shipments of soldiers' household goods.

Quickly set up from six panels of corrugated aluminum, the new "transporter" measures 8 ft. 6 in. long, 6 ft. 3 in. wide, 6 ft. 10½ in. high. It weighs only 900 lb. but can carry three tons. Weatherproof, it has "breathing" vents to stop condensation inside.

One of several models under development by the Transportation Corps, the crate can be handled by crane or fork lift or dragged on its skids. It fits into a railroad car or moving van, as well as a ship's hold. Two can be joined end to end to make a single double-size container, and three can safely be stacked one on another.

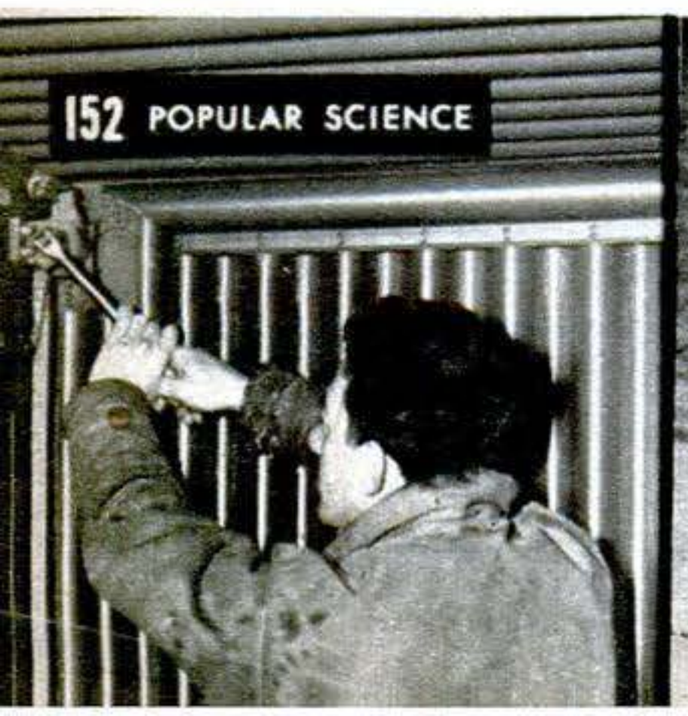
In tests, the transporter supported nearly ten tons on its roof, was dropped on one corner fully loaded, and rode through an 11-m.p.h. collision—all undamaged.





Knocked down for shipment, transporter is bundled with metal straps into a package less than a third the size of its own capacity. Each of six panels weighs only about 150 lb. Two men can assemble them in five minutes. Flanges along top and bottom of side panels lock into notches in roof and wood-decked floor. Rear panel is held by six bolts; front, serving as door, by four.

To balk thieves, bolts holding rear panel (left, below) are tightened from inside. Corner bolts pass through three fittings, one attached to each of panels that meet there. Bolts holding front panels have to be worked from outside (center). But their heads then are covered by shutters operated by combination-locking handle under a cover plate in center (arrow, right).



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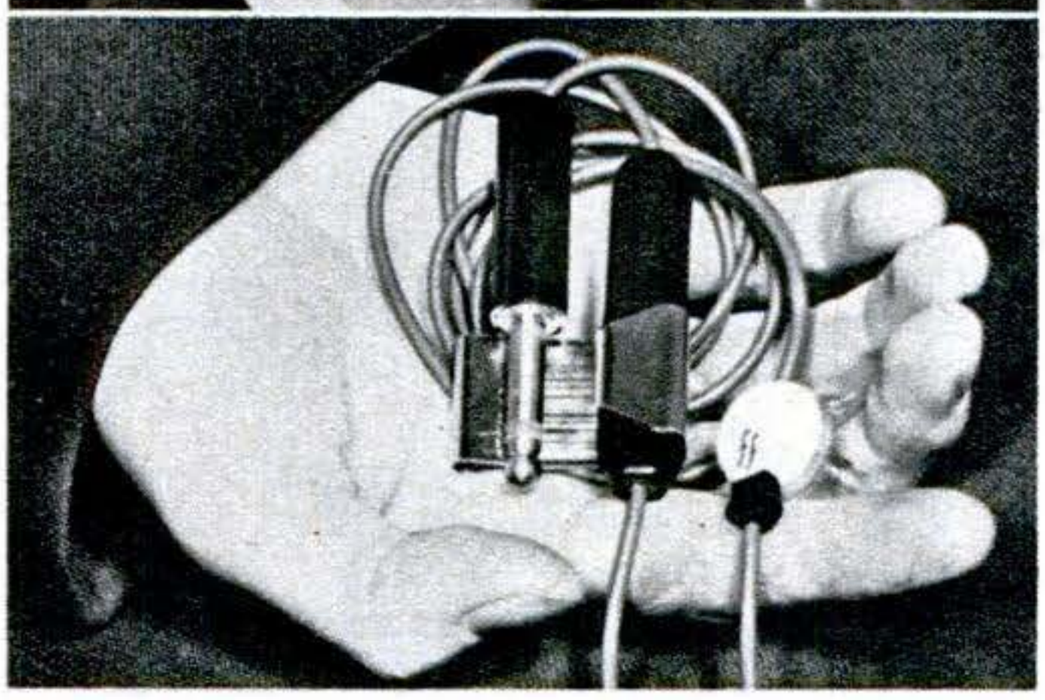


Earphone Takes Load off Pilot

SMALL as a nickel, this miniature Fly-Fone® radio headset fits snugly into a pilot's ear and brings signals directly to the eardrum. The maker, Air Market Associates, of Dallas, claims that the new device not only does away with the fatiguing pressure of old-type headsets but is 12 times more sensitive. The whole unit, shown held in the palm of a pilot's hand, weighs only 2½ ounces.

Helmet Helps Smog Study

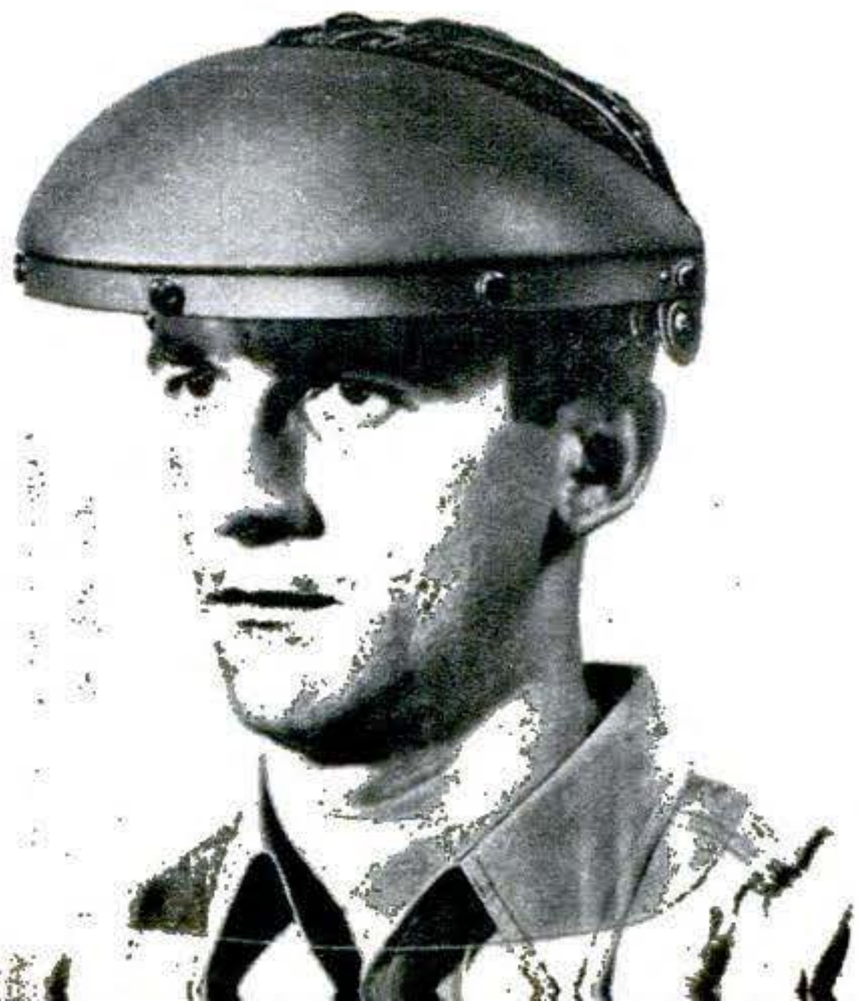
THE lady under this plastic headpiece is getting a dose of smog, made up of smoke and fog. Photoelectric cells attached to glassless goggles record blinks due to eye irritation. She reads a book to produce uniform reactions. The test is part of a study being made by Stanford Research Institute to find out more about the smog that often blots out Los Angeles' sunshine.

Plastic Guard Saves Face

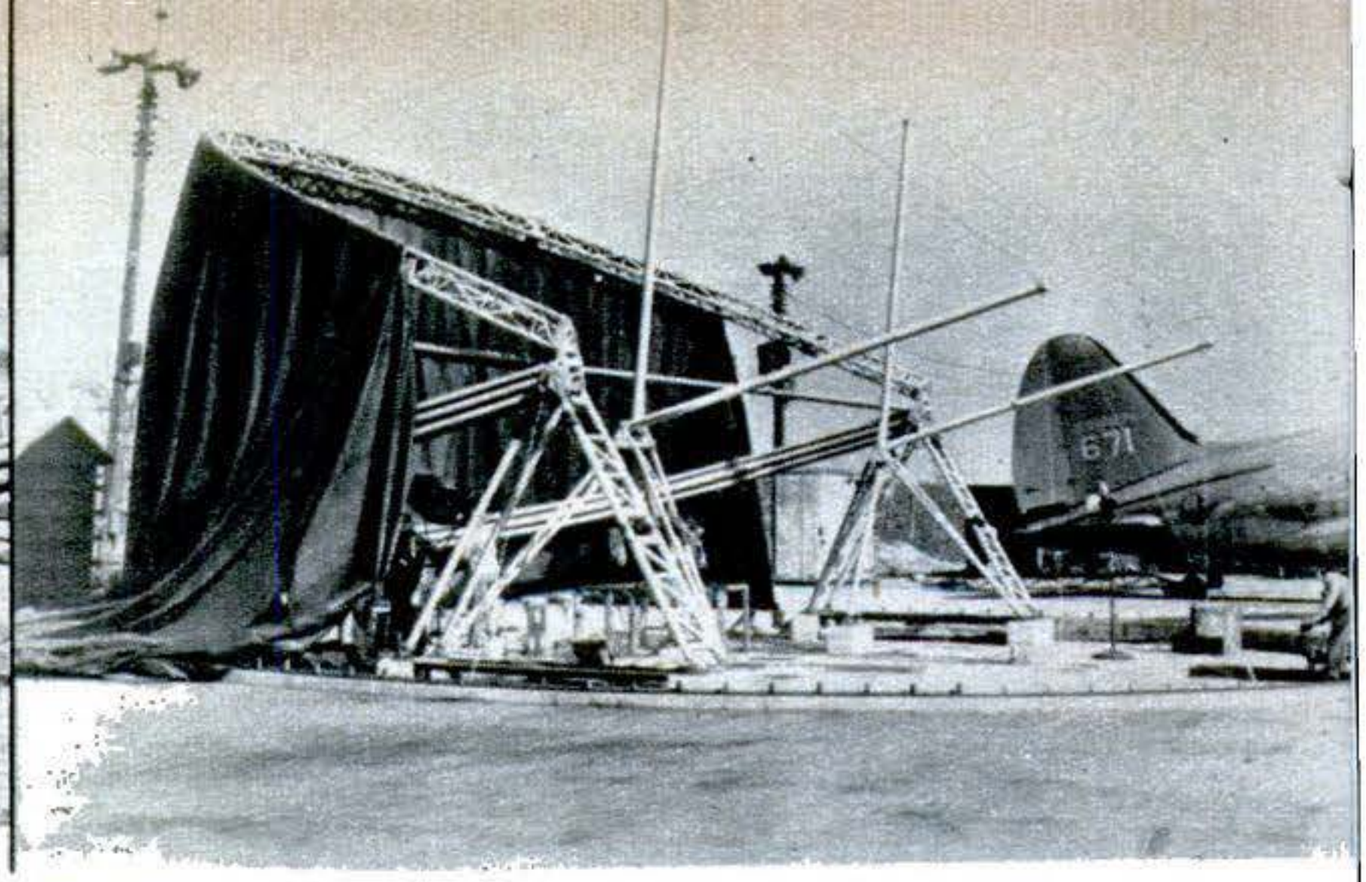
WHEN sparks fly, a worker wearing this new face shield is fully protected. A hard fiber top guards the forehead, while a non-inflammable, vinyl-plastic visor covers the face and neck. The turn of a knob adjusts the headband to fit any head. Made by the Mine Safety Appliances Co., of Pittsburgh, the helmet also offers protection against flying particles and splashing acids.

Glasses Built into Football Mask

THIS mask of cellulose acetate, with optically ground lenses, is science's latest contribution to football. Intended for players who require glasses, the new mask covers the face from forehead to upper lip. Breather holes prevent fogging. A rim of foam rubber cushions the shield against the cheek and forehead. The mask was devised by Dr. Edward Chase, of Los Angeles.



1 Workmen at left are unrolling the radome tarpaulin. A segment of the tent's skirt will then be fastened to the rim of the semi-circular aluminum framework seen in the center.



2 Here the radome goes up, much like an old-fashioned buggy top, with the fabric supported by a series of hoops. It is raised by ropes operating over pulleys on the V-shaped masts.

Radar Takes Cover Under the "Big Top"

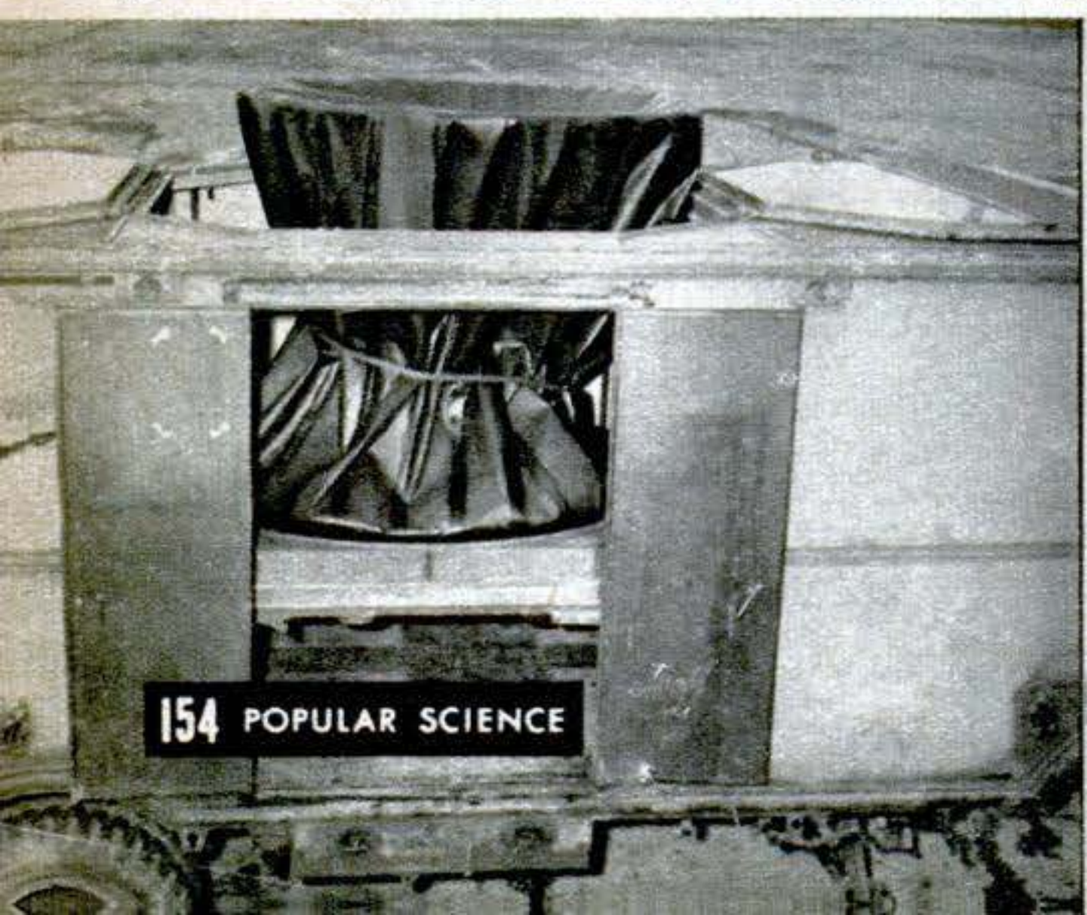
RADAR, so long kept under wraps for security reasons, now has gone under cover again. But this time it is "cover" in the literal meaning of the word – shelter to protect expensive and delicate equipment from the destructive elements of nature in extreme climates. "Radome" is the name for this balloon-like housing that is thin as paper, sturdy as steel, and does not interfere with the transmission of radar signals. Yet it is held up by air alone, with no supporting structures to get in the way of a radar set's swinging arms.

The big fellow shown on these pages is an Air Force job. It is 36 feet high, 50 feet in diameter at the base, and is made of Fiberglas® coated with synthetic rubber. When inflated, it is strong enough to support two inches of snow or ice, and to stand up under 130-m.p.h. winds. If internal heating is insufficient to remove ice coatings, a "mechanical spanking" – a slight alternate deflation and inflation – will do the trick. For hot climes, the big bag can be air-conditioned.

Illustrated at the bottom of this page is the baby counterpart that does the same job for the Signal Corps' mobile radar units. Nine feet in diameter, this miniature version is made of Neoprene®-coated Fortisan® rayon, which, says the Signal Corps, transmits radar signals better. It is inflated by a unit from an ordinary tank-type vacuum cleaner.

Both radomes were designed by the Cornell Aeronautical Laboratory, Buffalo, N. Y., in conjunction with the Air Force's Watson Laboratories and the Signal Corps Engineering Laboratories.

Baby radome takes a bow. At left below it is shown deflated, and serving as a cover for the gun-directing radar set that is being raised from its trailer storage compartment. Bubbled at right, the thin fabric is held up by an internal pressure of only ¼ lb. per sq. in. from a vacuum cleaner.



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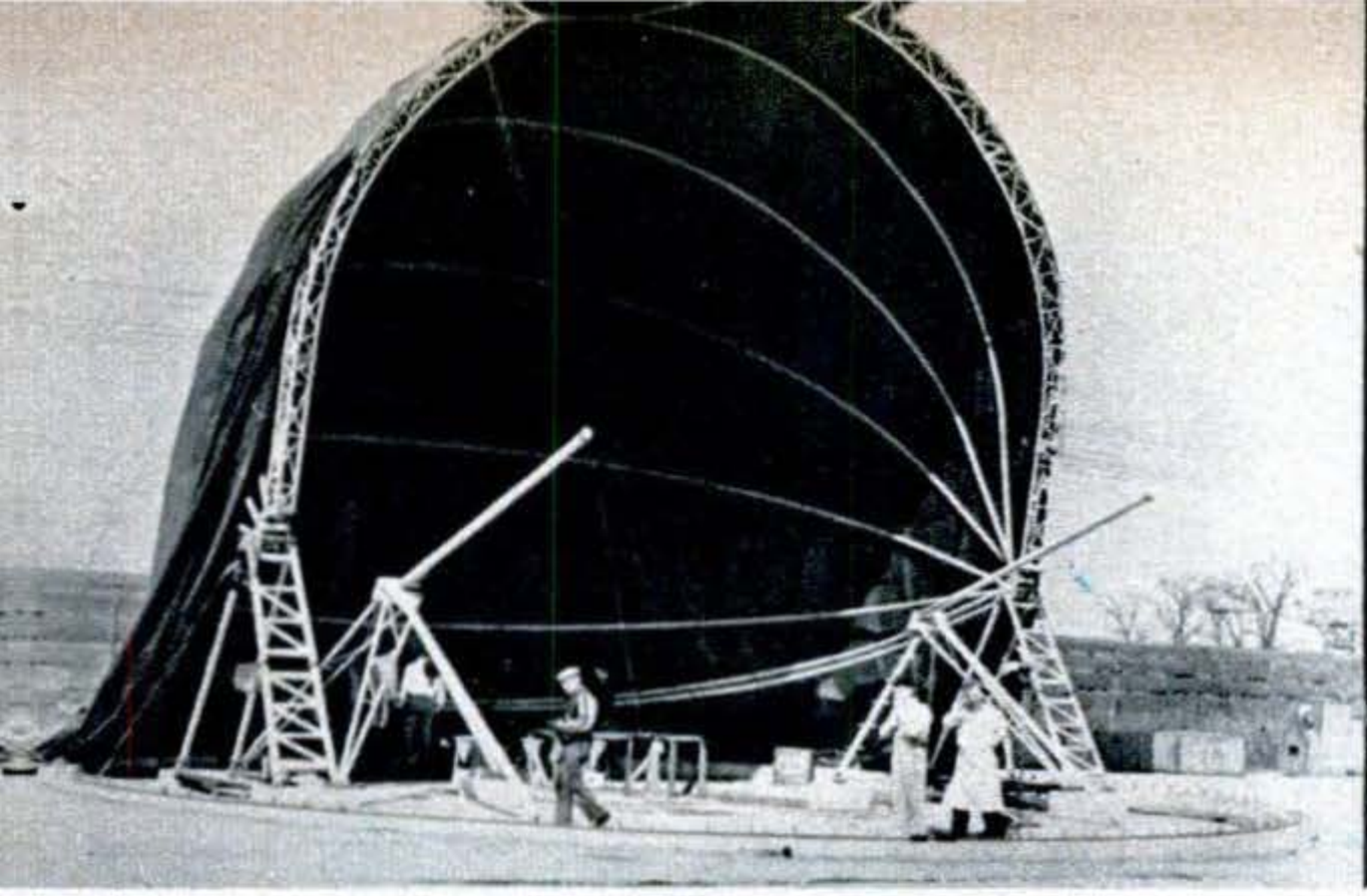
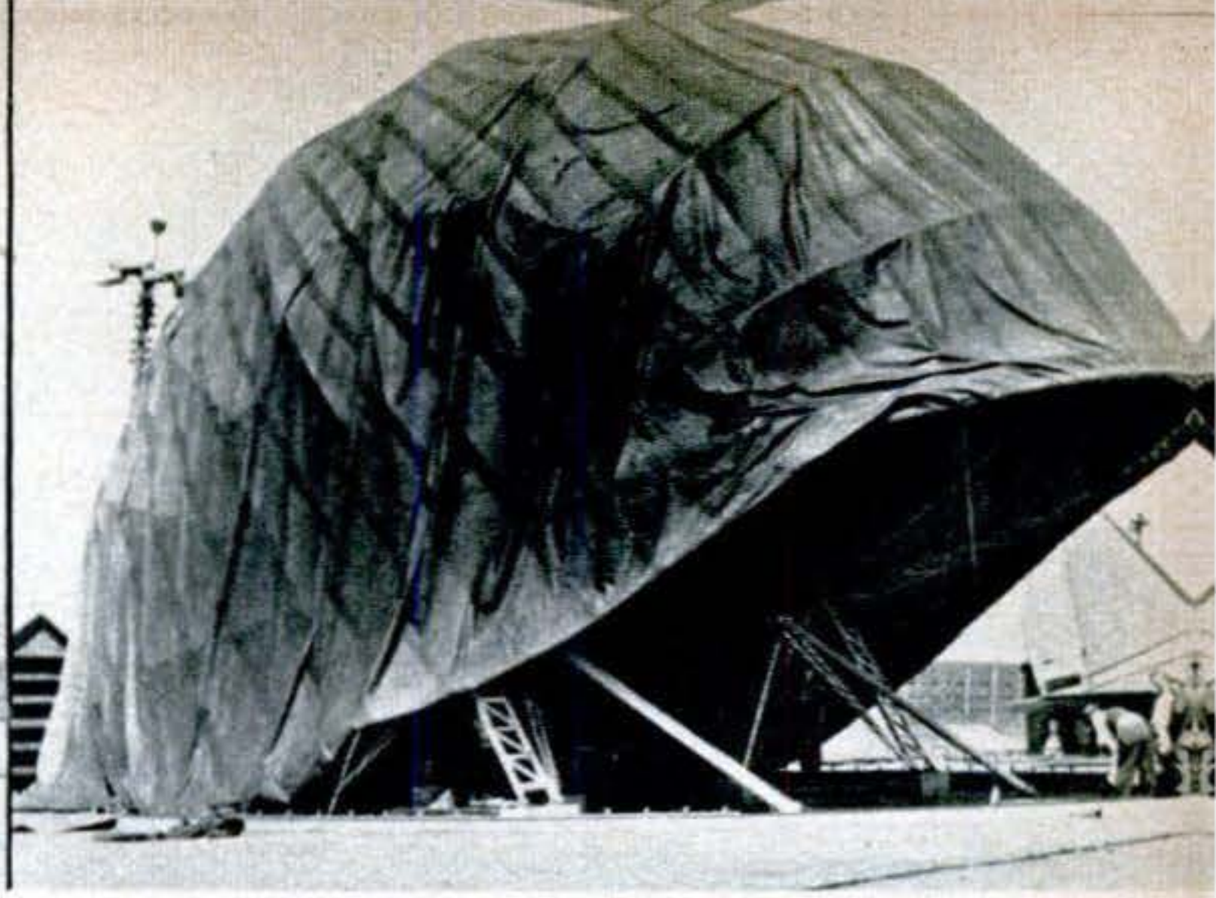


3 **This half-way-up view** clearly shows the raised circular concrete lip that rims the 50-foot-diameter floor. Wooden framework in center surrounds entrance from underground tunnel.



4 **Coming down.** Next step is to clamp the hem of the radome's skirt to the concrete lip. After it has been inflated, the hoops are collapsed and the raising derricks dismantled.

5 **All blown up.** Engineer walking up the side with the aid of a rope doesn't even make a dent in the taut fabric. Special pressurizing machinery is used for inflating the big top.

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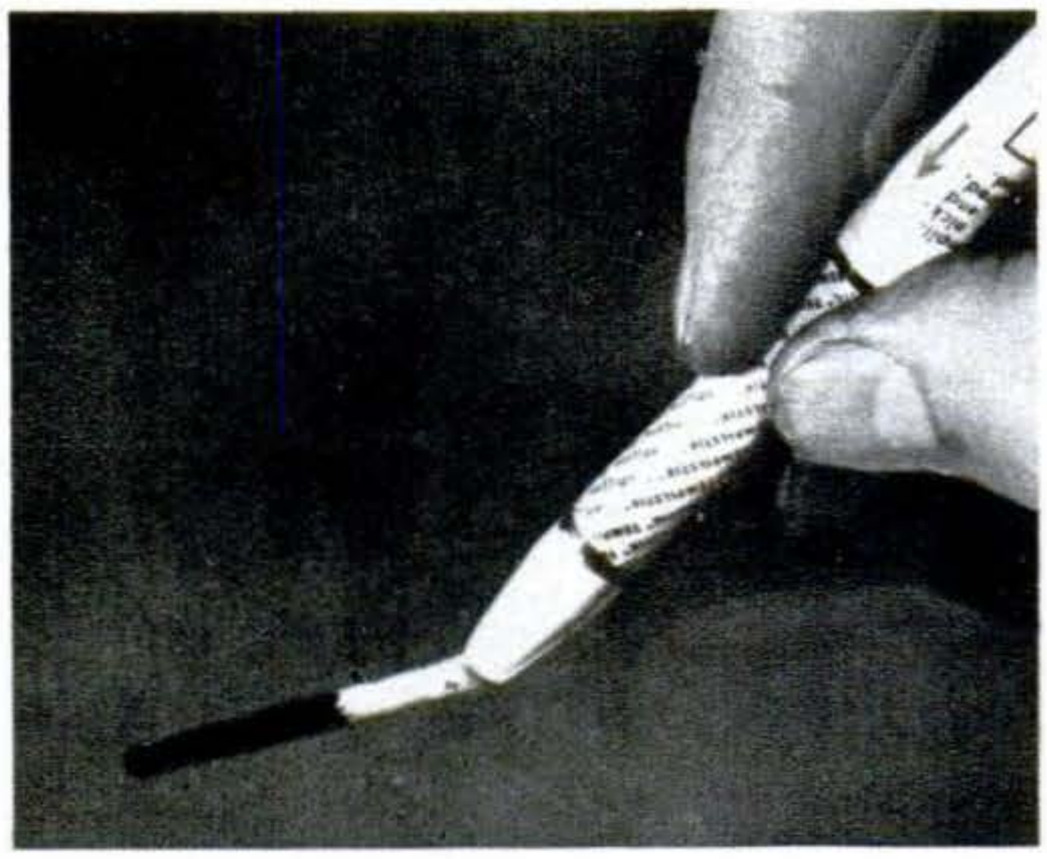
Water Stored Under Street

THE city of Santa Monica, Calif., neatly solved the problem of where to store 5,000,000 gallons of drinking water by digging a reservoir under a wide, hilltop street. The pavement was ripped up and a trench 660 ft. long, 29 deep, and 50 wide was dug and lined with two feet of poured concrete. Four feet of earth were then put on top of the giant tank and the pavement re-laid. Pavement and traffic are supported by 64 concrete columns.

Ax is All-Purpose Tool

THIS ax tells almost everything about a tree – besides cutting it. The reverse edge has a circular cutter that brings a neat core out of the trunk for measuring growth rate. One-foot marks on the handle permit quick calculation of tree diameter. When handle, held erect at arm's length, covers tree, distance from you to tree is same as tree's height. Woodsman Tool Co., of Tacoma, Wash., makes the ax.



Crayon Tells Temperature

CRAYONS that tell how hot a piece of metal is are now available for temperatures from 130° F. to as high as 2,000°. A smear made with a Tempilstik® starts to liquefy only at the temperature marked on the crayon. Used in welding, tempering, forging, and casting, the heat-sensitive crayons – and similar pellets and lacquer – are made by the Tempil Corp., of New York City.

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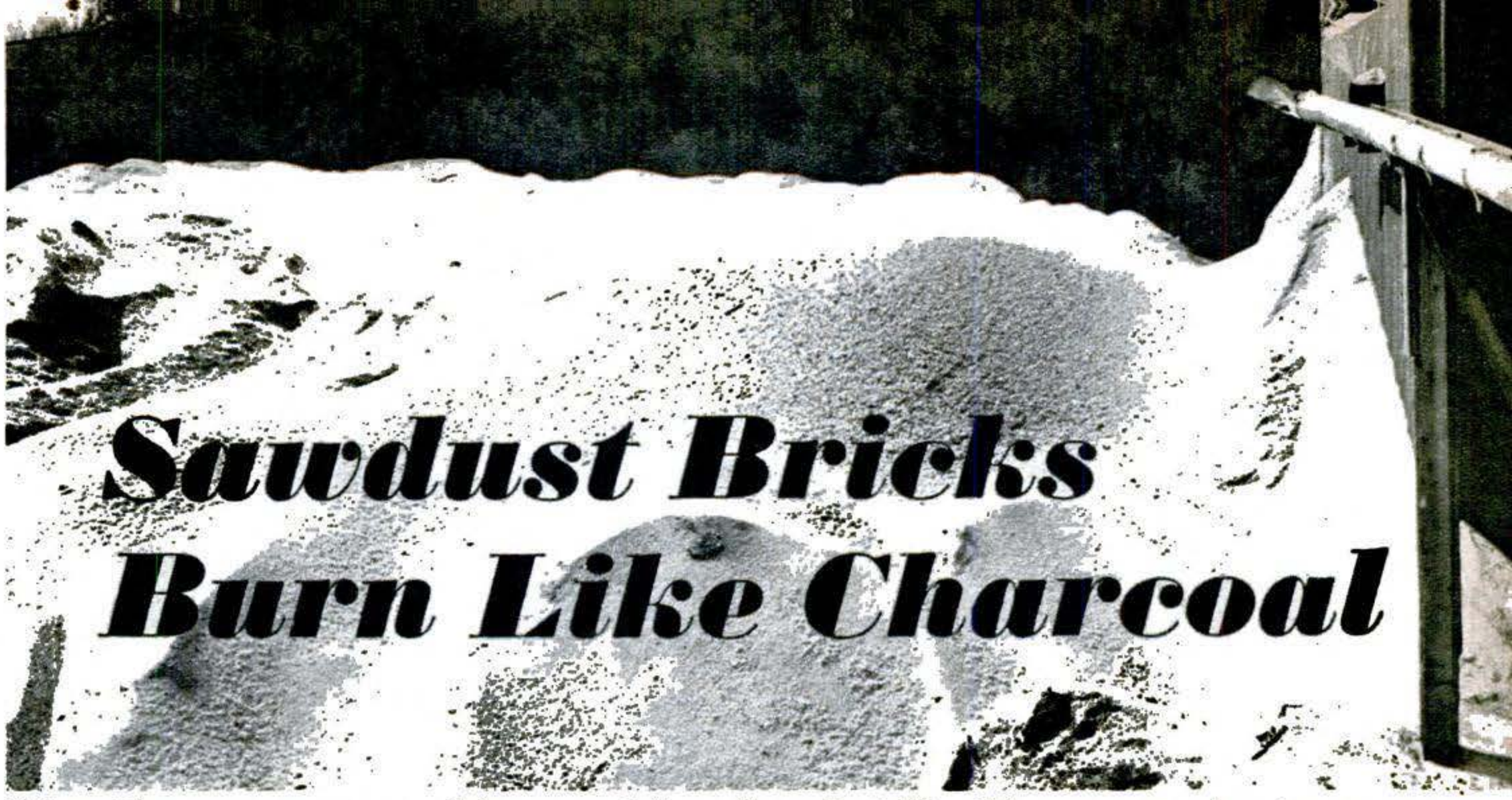
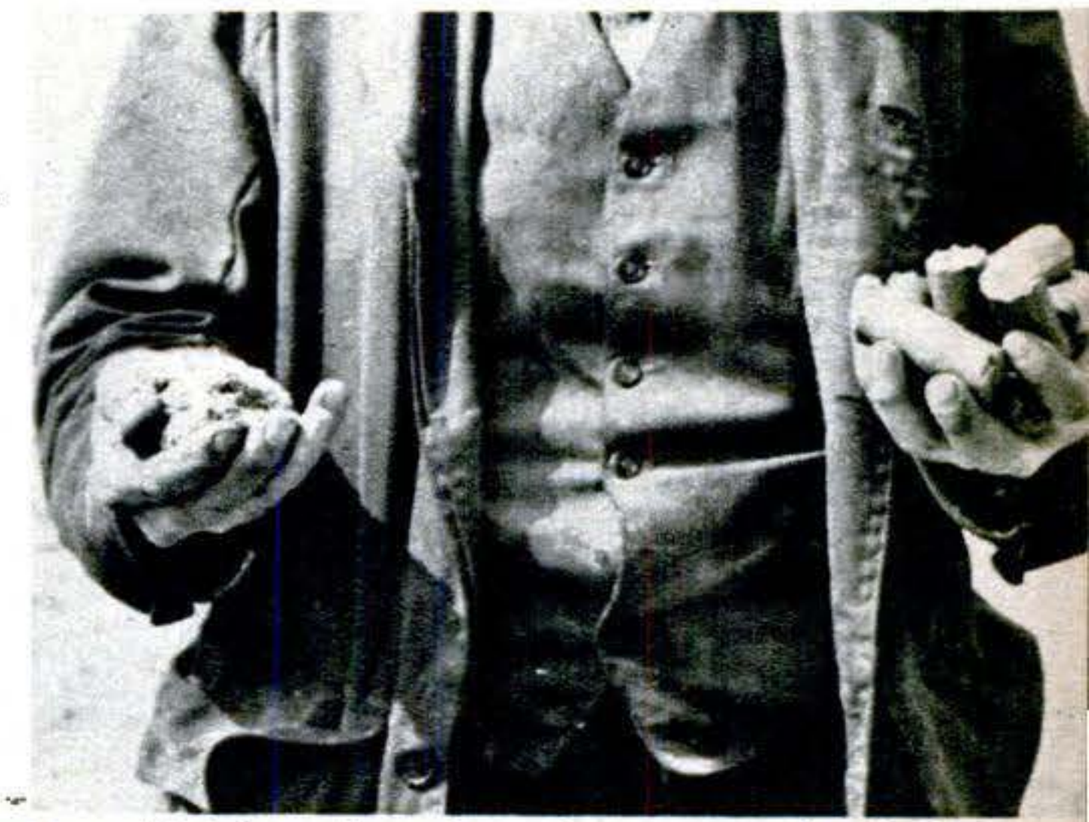


Sawdust Bricks Burn Like Charcoal

Briquetting process may reclaim mountains of sawdust like this one, covering two acres.

WALTER W. LETTS doesn't look much like that mythical giant of a lumberjack, Paul Bunyan. Yet he has successfully imitated one of Paul's tricks—running a sawmill backwards to make good logs out of waste. Letts turns waste sawdust into useful briquettes, finger-sized cylinders that can be burned like charcoal. Others have tried this, but few have succeeded economically.

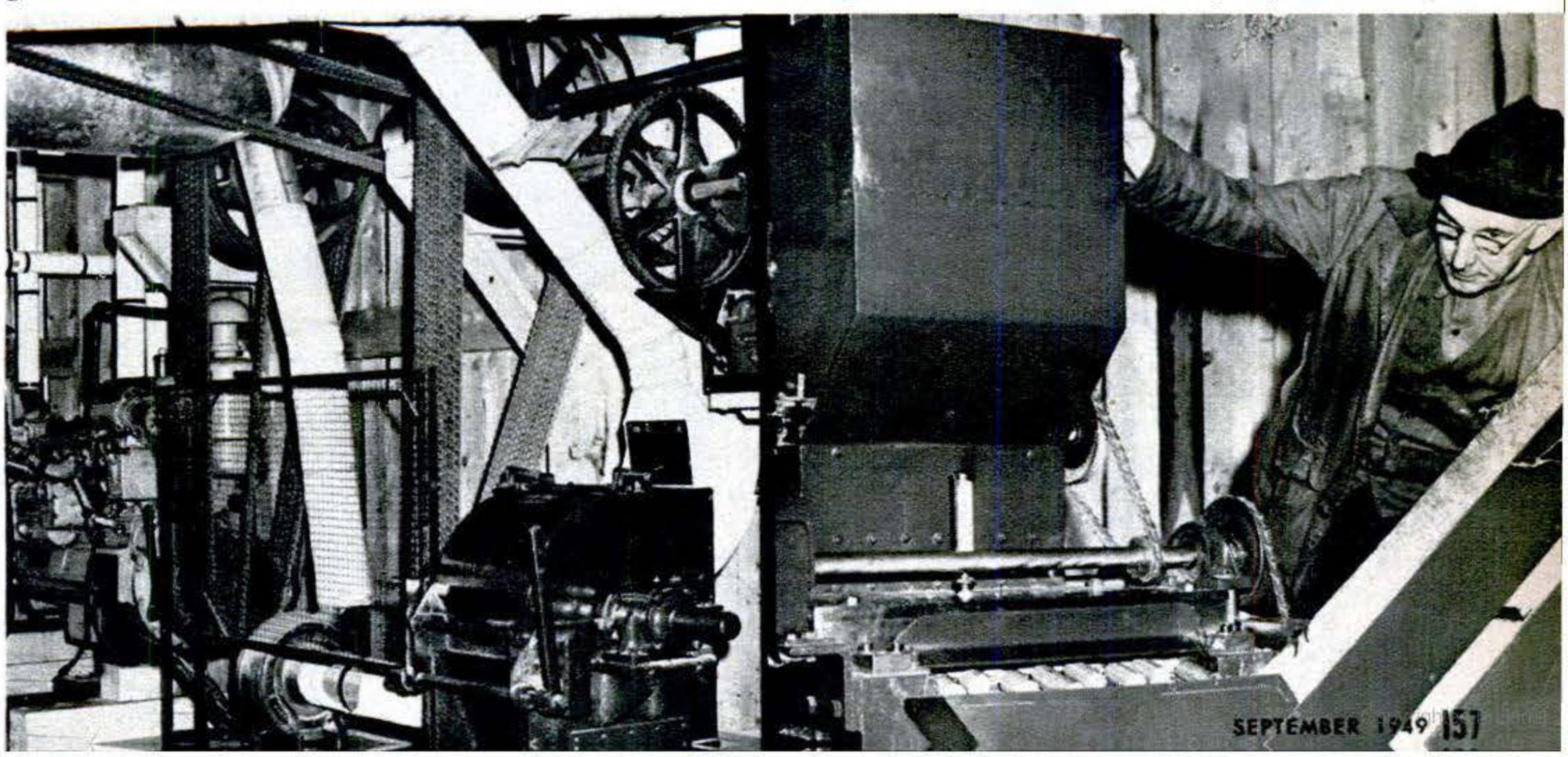
A Northville, N. Y., lumberman, Letts dries sawdust in a machine he designed himself. Its whirling blasts of hot air remove 95 percent of the moisture. A second machine then applies pressure of 12 tons per square inch to the sawdust to solidify it into the briquettes. They burn with a blue flame, leaving an ash of only 0.1 percent of their original volume.



Sawdust (left) makes these briquettes (right), called Burnets® by their inventor, Walter W. Letts. Burnets burn with a very hot, even flame, can be used for the same purposes as charcoal.

Inside the small plant, hammer mill (foreground) grinds waste sawdust—from huge pile behind the wall—to uniform size. The dust then goes to drier that removes most moisture.

The final step compresses sawdust into solid cylinders with a pressure of 12 tons per sq. in. Then the briquettes roll out of the machine like sausages and are carried away by a conveyer.



So You Think 32° Is Freezing?

THE textbooks say pure water turns to ice at 32°F. But now GE researchers have proved the books are wrong. Absolutely pure water, they found, won't freeze until you cool it down around 4° below zero!

In a series of experiments at the General Electric Research Laboratory, Robert Smith-Johannsen carefully cooled drops of water in a special apparatus (shown in drawing and photos at right) while he watched for ice crystals to form in the drops. No ice could be seen in pure water until the temperature fell to about −4°!

Ice still melts at 32°, though. And water *mixed with ice* freezes at 32°. It is absolutely pure water *free of ice crystals* that won't freeze down to −4°. Some impurities make water freeze above that point, although always below 32°. Apparently the impurities "look" like ice crystals to the water molecules. The water freezes on them just as it would on real ice crystals.

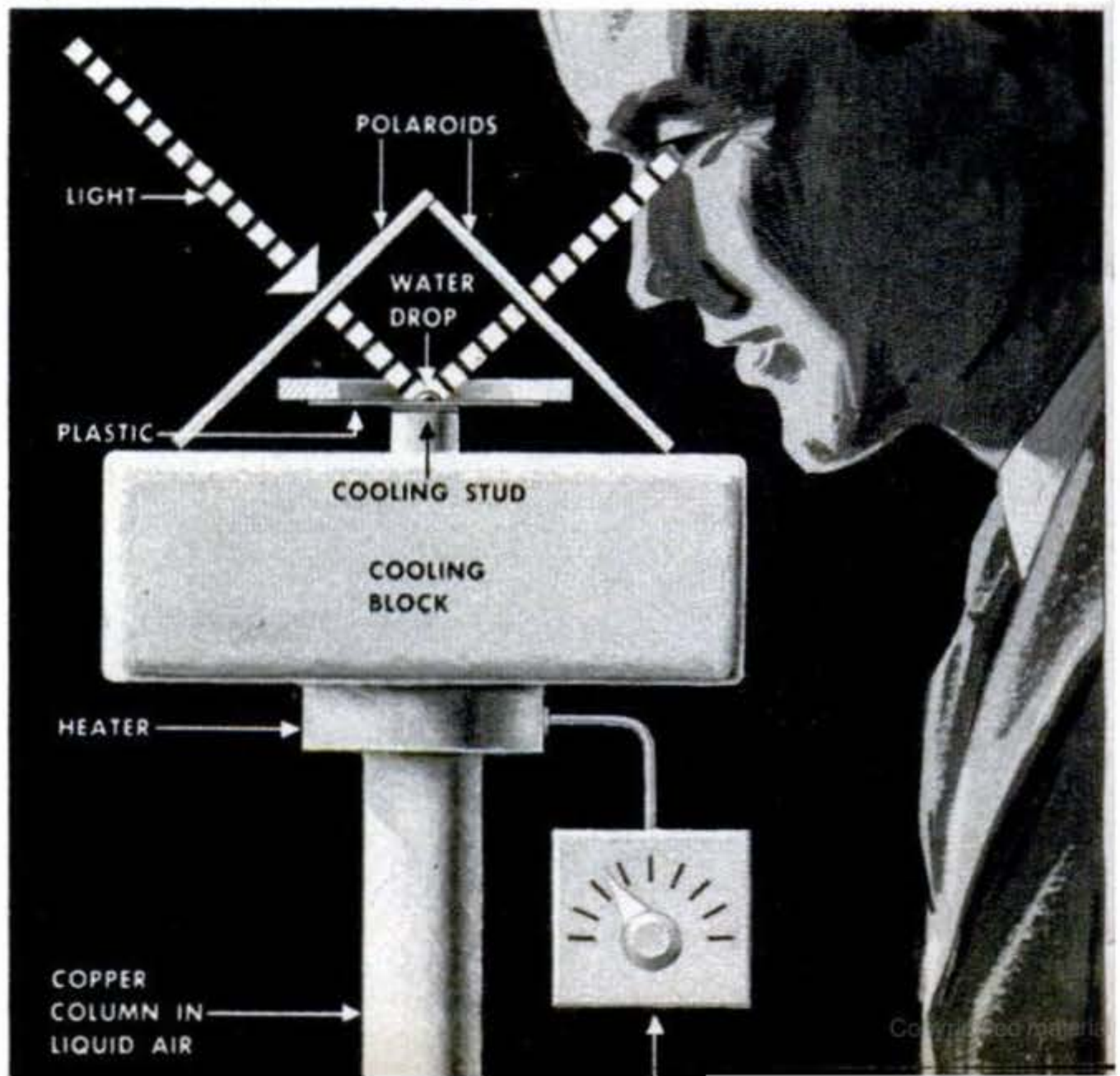
Scientists have known for a long time that water could, under certain conditions, be cooled below 32° without freezing. This "supercooling" was always considered a freak, but must really be normal, says Johannsen.

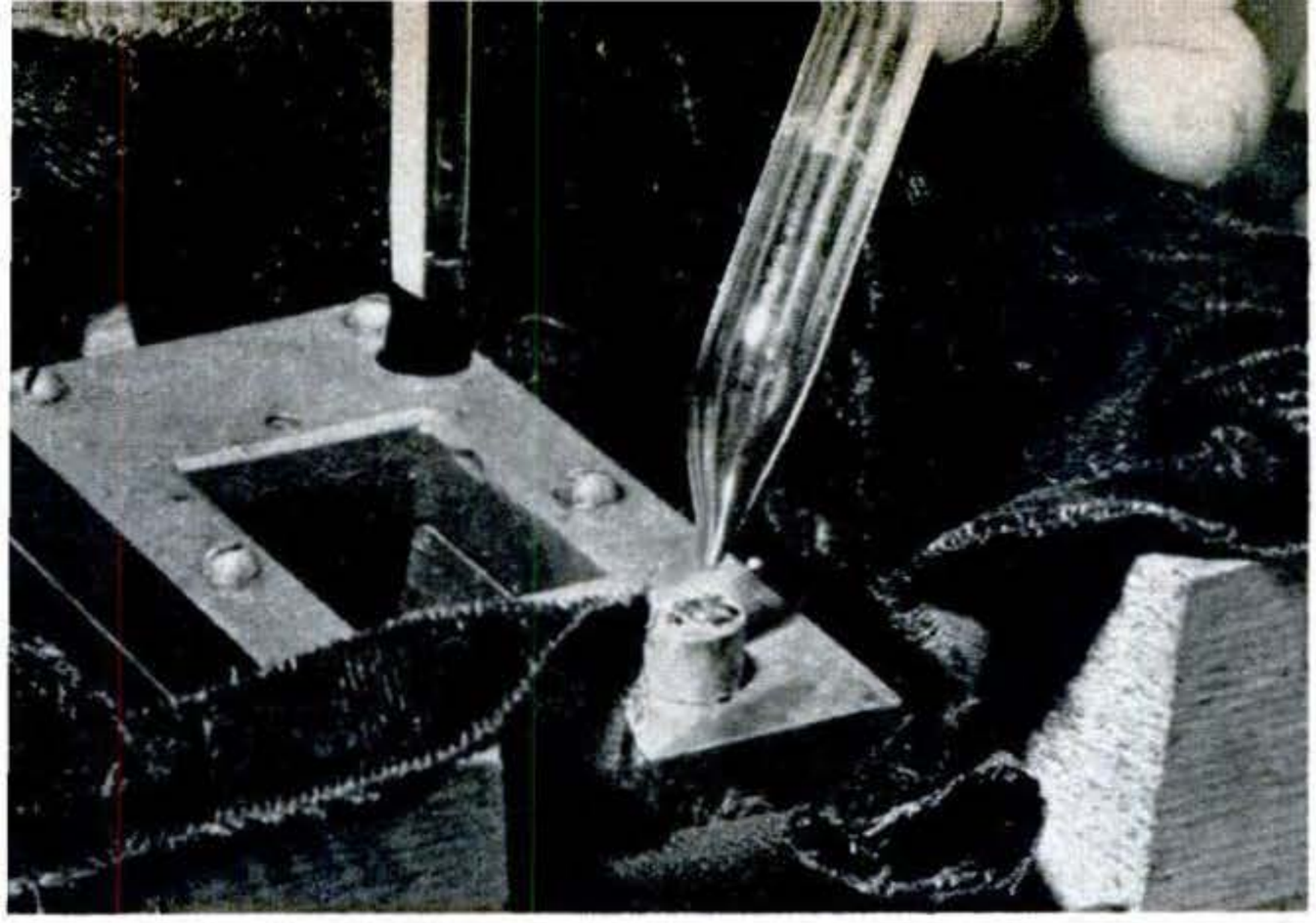
The GE researchers tried treating pure water to make it freeze above −4°. Nothing worked – except adding impurities. They found, however, that passing high-frequency sound waves through the water lowered the freezing point still further. Apparently the ultrasonic waves changed the size or shape of impurities still left (even the purest "pure" water has some) so that they no longer could fool the water molecules.

What makes a mud puddle freeze on a night when the thermometer hovers at 32°? Johannsen answers: a tiny ice crystal from the much colder sky must fall into the puddle. He says, "The only way to get water to freeze at 32° is by adding an ice crystal!"

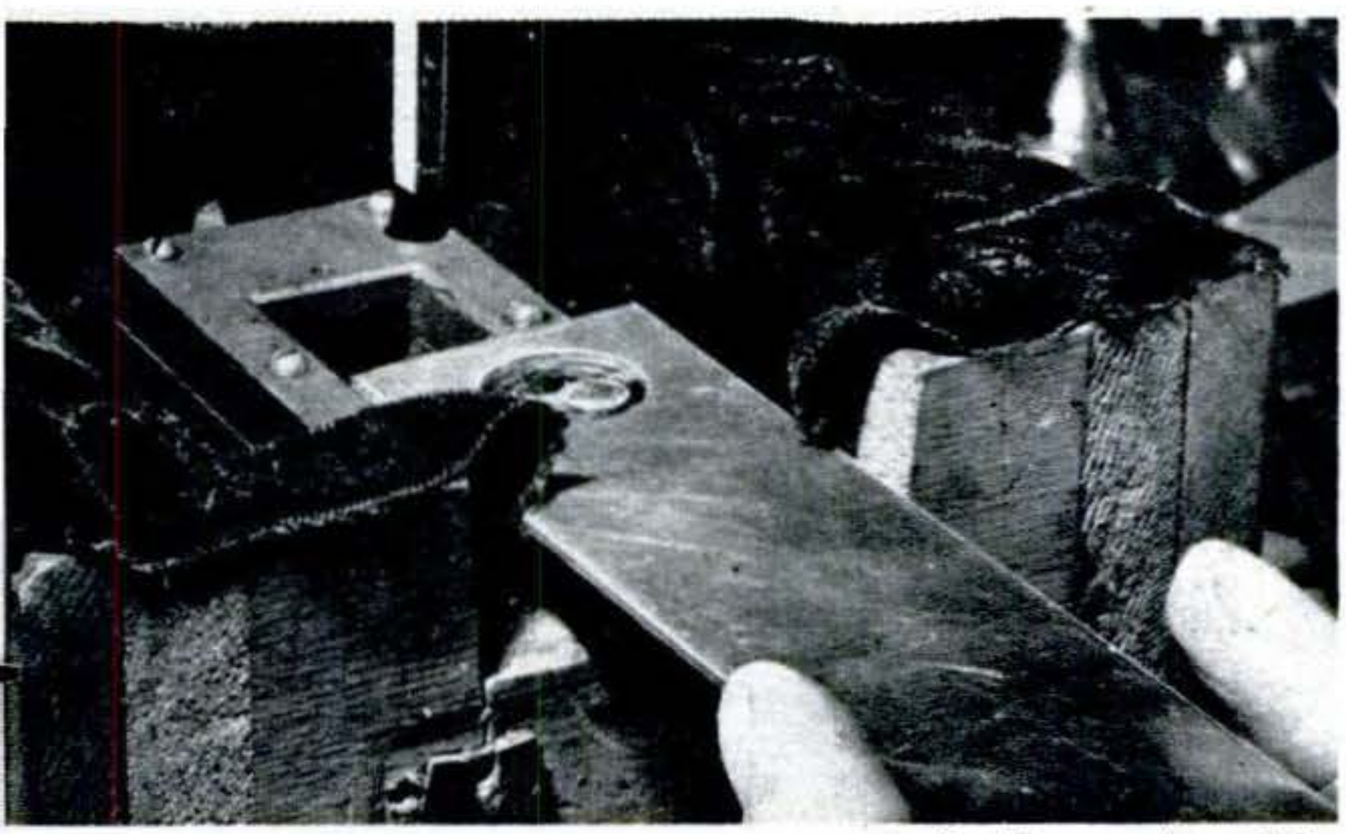
Peering through Polaroids®, Johannsen can spot the tiniest ice crystal because it changes light polarization while water does not. Vacuum flask (bottom) has liquid air to cool water.

Diagram below shows simple equipment used. Water temperature is precisely controlled through combination of cooling by conduction to the liquid-air flask, heating by electric wires.



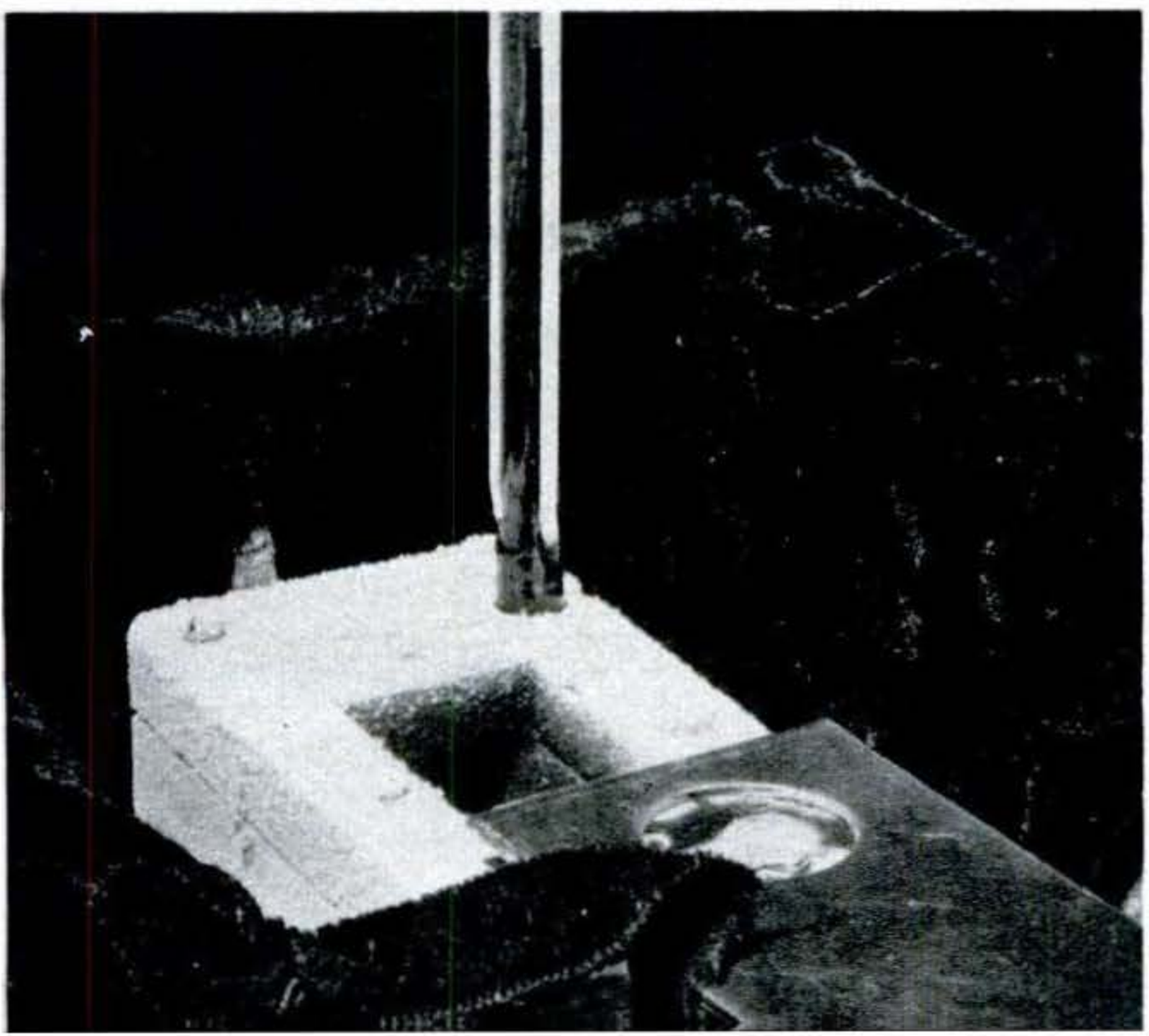


1 Placing film of mercury on stud atop cooling block is first step in finding true freezing point of water. Mercury gives mirror surface for easier observation, aids heat conduction.



2 Drop of pure water is held on ultra-thin plastic set into hole in metal strip. The plastic rests directly on the mercury-coated stud, so water quickly acquires stud temperature.

3 Rheostat changes temperature of stud—and water—until ice crystal forms, as it has below. Standard thermometer stuck in cooling block shows temperature at which ice appeared.



New Washer Squeezes Dry

WATER is squeezed out of the family wash in almost the same way used by an old-fashioned laundress in the new automatic Bendix washer below. When this agitator type of machine finishes washing and rinsing, a vacuum is created inside the tub. This sucks the flexible plastic lining in, squeezing the wash damp-dry. Dirty water goes out the top of the hollow agitator shaft, not through clothes.

Drawings show how tub collapses, pressing water out of wash. Arrows (right) show undertow swirling of clothes as agitator twists. Below (left) tub partially collapsed; (right) lining fully collapsed.

Clothes are fed through top of vibrationless washer. Inflowing water passes through hose (at bottom of airtight cover in photo) and then through the valve in the lid's center.

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These Firemen Jump to Work

FROM the top of a mountain deep in a national forest, a lonely lookout slowly scans the neighboring slopes. Suddenly his eyes focus on a tiny puff of smoke. Within a few minutes a plane loaded with paratroopers heads for the fire.

These paratroopers carry no guns. They are the "smokejumpers" of the U. S. Forest Service, trained to parachute into isolated wood areas and put out a fire with only the tools dropped alongside them—there seldom is water. Then they must find their way afoot to the nearest road and civilization. In one year alone, the airborne firemen made 1,236 individual jumps, fighting fires in public and private forests in the Northwest.

Smokejumpers of the Forest Service get ready to step into space to fight fire below. Various kinds of planes, including the reliable old DC-3—and even ancient Ford Tri-Motors—are used.

Hand tools are jumpers' main fire-fighting equipment. They don't attempt to extinguish blaze, but isolate it by cutting a clear path around it, then let it burn out. Moist earth is turned to prevent smoldering. Smokejumpers are most often used against small fires—frequently caused by lightning—in areas remote from roads and trails. They also rescue lost or injured persons.

Parachutes used by smokejumpers have two narrow slots cut in rear, permitting jumper to guide descent, pick- landing. Slots were developed by a smokejumper.

Portable short-wave radios keep jump teams in contact with ranger station. This and other equipment is dropped from plane, but men carry own food supply.

Fully equipped smokejumper wears high-collared canvas coveralls and football helmet with wire-screen face guard to protect him during a treetop landing. Back 'chute is released by static line; chest 'chute is emergency spare. Leg pocket holds rope for slide from a tree to the ground.

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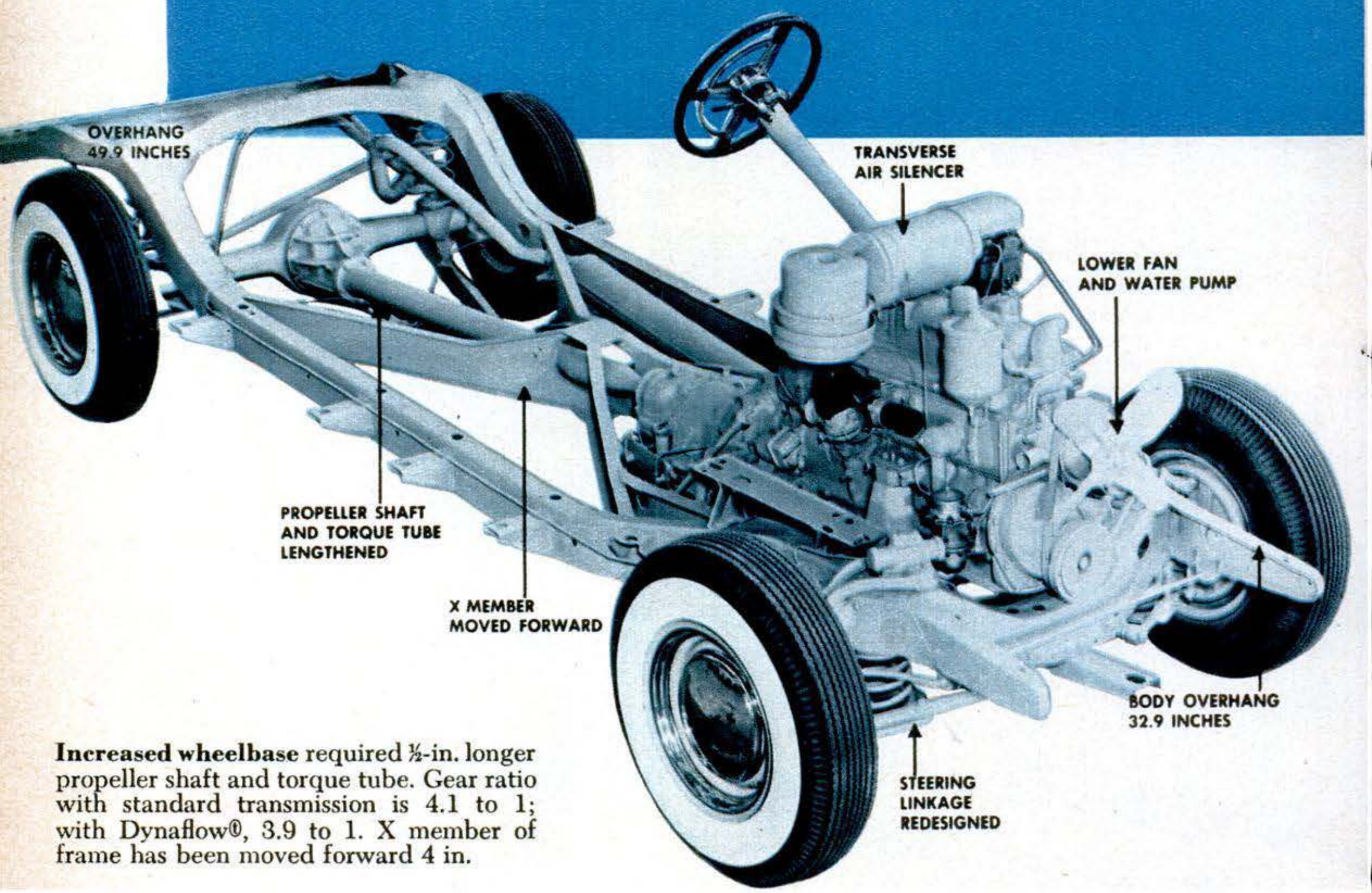
Buick Slicks Up Its Big Little Car

Out of production for nearly a year, the Special makes a new bid for a share of the auto market, offering increased safety and comfort.



Increased wheelbase required ½-in. longer propeller shaft and torque tube. Gear ratio with standard transmission is 4.1 to 1; with Dynaflow®, 3.9 to 1. X member of frame has been moved forward 4 in.

By Devon Francis

PS photos by W. W. Morris

A DOZEN years ago Buick automobiles broke into the country's best-seller list with a "little" car tailored for the man who wanted something better at an in-between price. It was given the unimaginative name of "Special" and promptly became the best-known vehicle in the company's entire line.

Last month GM's Buick Motor Division announced its new Special, the biggest "big little" car it has ever produced.

In its refurbished form, the Special, out of production since last December, is an obvious lineal descendant of the sleek car designed just before the start of the war—the car that sold like hot cakes after the war, with scarcely a change in dies. But the new Special em-

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New "buck-toothed" Buick has heavied-up, exaggerated grille. Loaded, car is 61.7 in. high, 3 in. lower. Hood is 1.7 in. shorter. Beside car is Ivan Wiles, new Buick general manager.

Family lineage of new Special is shown by close resemblance to predecessor above. Fender line in both is carried back into door, but new car has no chrome side trim except around vent ports.

bodies the first major changes in nine years.

Only a few of the many modifications in the car are evident. It looks much the same. Detroit, like Hollywood, doesn't like to abandon a winning formula. But the engineers have built what amounts to a new automobile inside the familiar Buick look.

It's lower. It's shorter. It's roomier. It's quieter. For the first time, Dynaflow® drive (PS, Feb. '48, p. 113) is offered as optional equipment. As a safety feature, there's an increase in the driver's field of view that's little less than spectacular.

And what Buick probably will toot about most of all is the creation of what it calls a two-level system of heating. Automobile owners—and women in particular—have always complained about cold feet in the winter. Buick has mended that. At the "breath level" the air can be a comfortable 70° F. At the foot level it can be 90°. The trick lies in redirecting the flow of air from the outside and recirculating it around the feet with added warmth from a second heater.

The increased visibility came about when the stylists and body engineers got their heads together and decided on a revolution. For years, when drawings of proposed model changes were trotted in to undergo the bilious gaze of top management, hoods were sketched shorter and lower. Everyone thought they looked fine. But they always got lost in the shuffle. Buick hoods continued to be just about as long, just about as high as ever.

Now, the shorter hood has won out. In the new version, a bump on the road can be seen 24 feet closer to the front bumper and 18 feet closer to the rear bumper through the rear-view mirror. Windshield area has been boosted to almost half again as much as on current models. "Backlight" (rear) visibility is increased even more. From the driver's view, the windshield and body pillars have been slimmed down a full inch.

Structurally and mechanically, the changes are subtle. The X member in the frame has been moved forward 4 inches, permitting a shorter transmission support. Bolts are few; the frame is almost completely welded. A single, beefed-up roof bow replaces three smaller ones.

Except when Dynaflow is ordered, there is no change in the engine horsepower or

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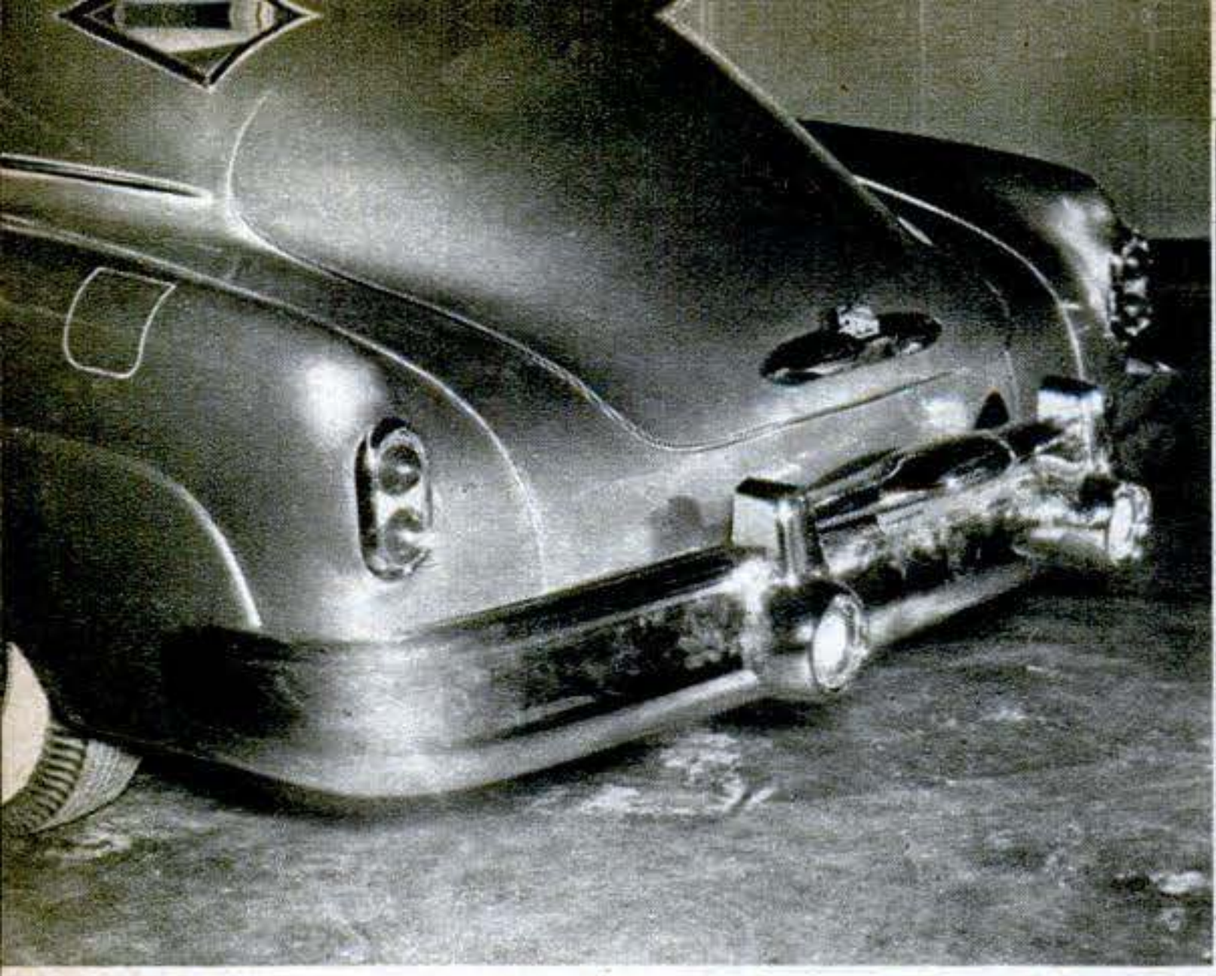
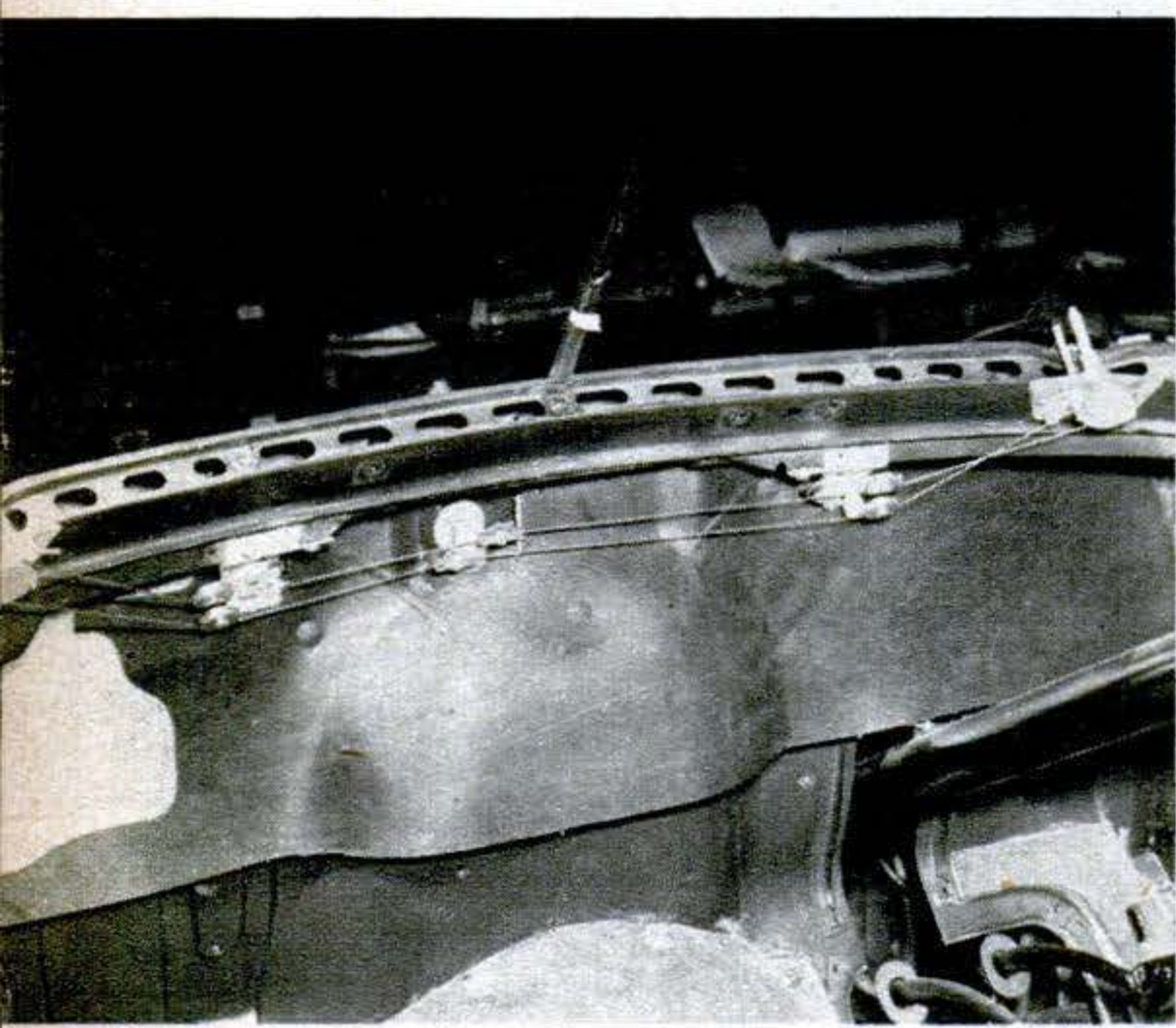
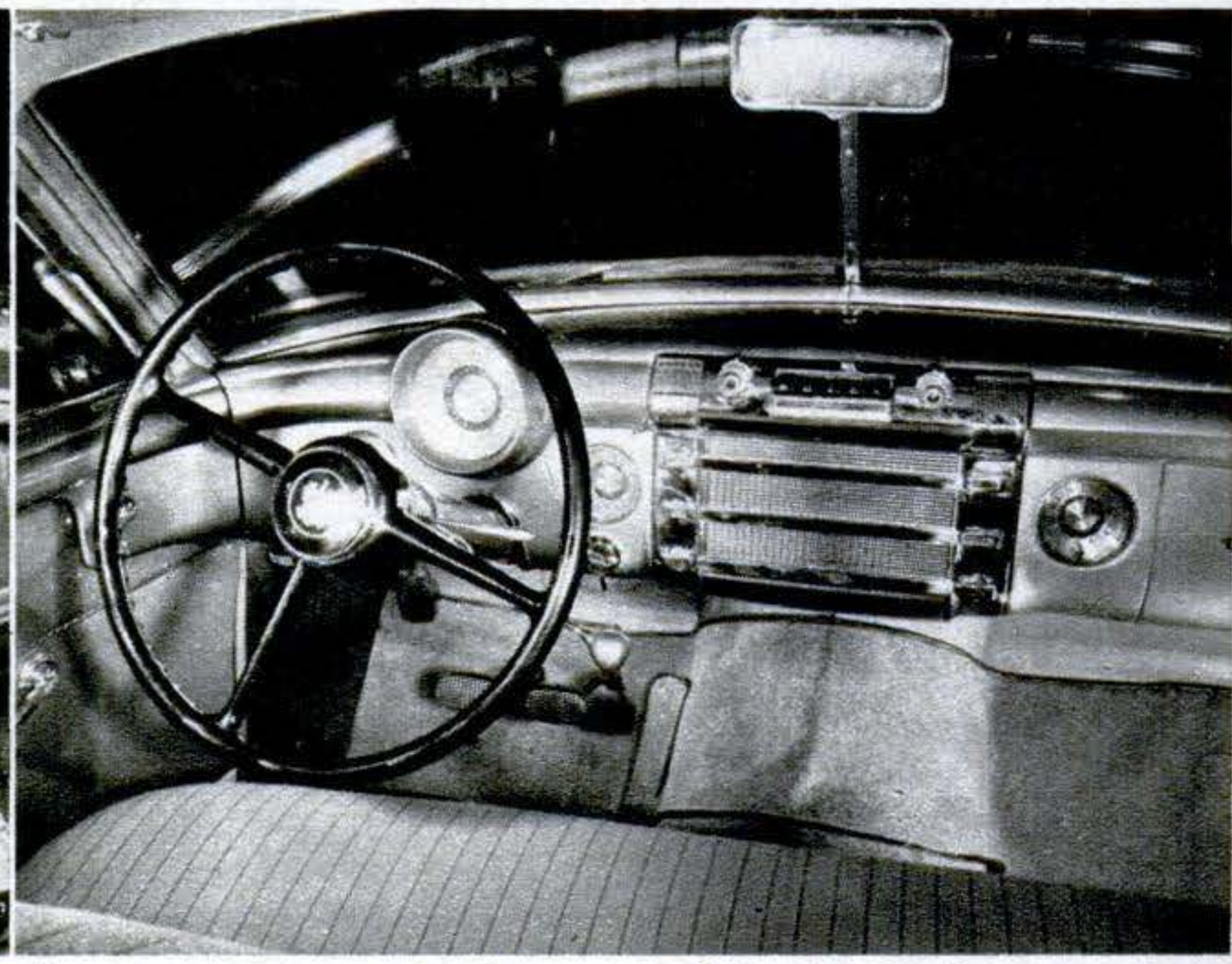


Lights on rear fenders include tail and stop, reflector, and provision for direction signals. Lamps in bumper are optional back-up lights. Car was shortened 3½ in. by pulling in bumpers.

Bead on edge of front-fender cutout permits greater wheel enclosure without decreasing turning radius. Rear fender extends 7 in. lower over wheel, eliminating need for fender skirts.



Heated air enters car through openings along base of windshield. Defroster air volume has been boosted 83 percent. Below air inlets are wiper cables and tensioners to prevent lash.



Instruments are closely grouped in front of driver. Glare-proofed mirror for night driving is optional. Area swept by windshield-wiper blades has been increased from 379 to 523 sq. in.

transmission. Its engine is a 110-hp., in-line eight. The fan and water pump have been lowered to permit a lower hood, and the fan has been slowed down to reduce noise. The transverse type of air cleaner and silencer has been adopted.

All in all, the styling is pleasing. Most of the chrome has been stripped from the sides of the car. That's okay, but now they've gone and plastered still more glitter on the front end. The fact that most of the grillwork is replaceable in sections should appeal to the man who fears a parking-lot collision.

In the interest of economy, the Special has abandoned the pull-type interior hood openers and substituted a key that is inserted in the front hood porthole. The idea is that the attendant at the corner filling station will carry a key around in his hip pocket to release the catch. But a screwdriver will do, if the key gets lost.

A noticeable addition inside the car is a space above and back of the instrument panel that is practically a shelf. The company is waiting for reports on that—no telling what a woman driver will deposit there.

The Special differs from the two other Buick series in equipment, optional extras, power (except with Dynaflow), compression ratios, and weight. Dynaflow is standard now in the Roadmaster, optional in the Super and Special.

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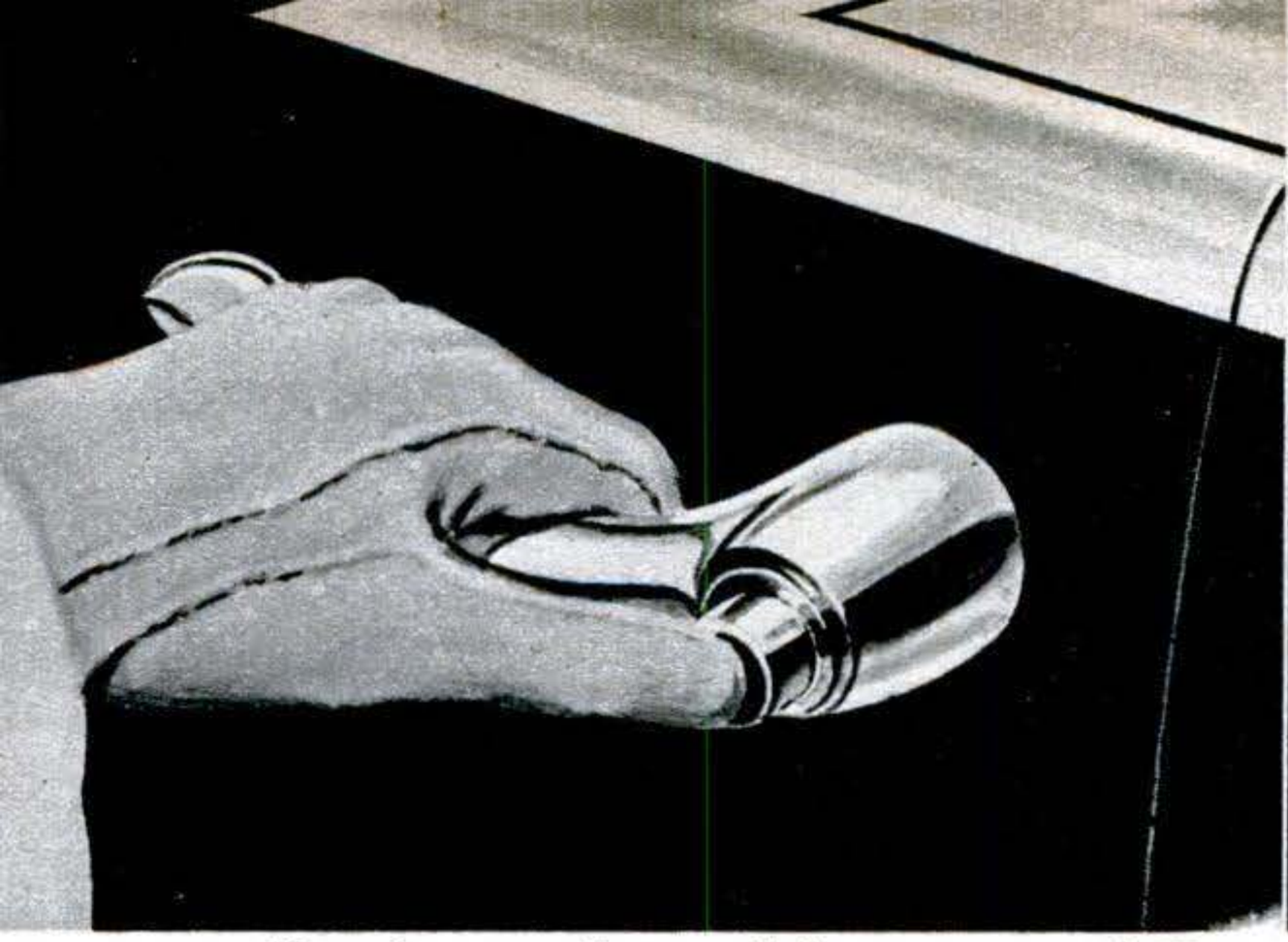
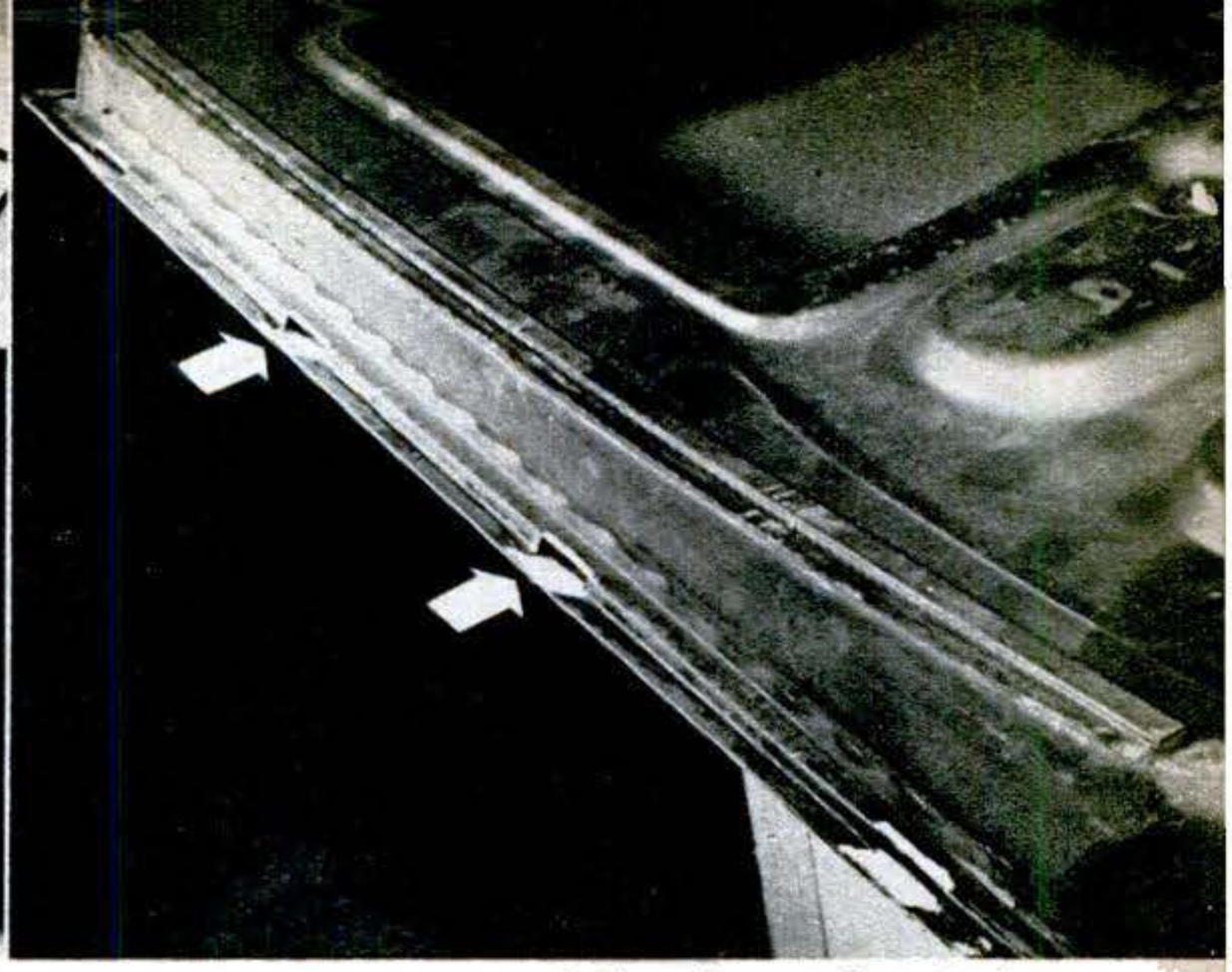
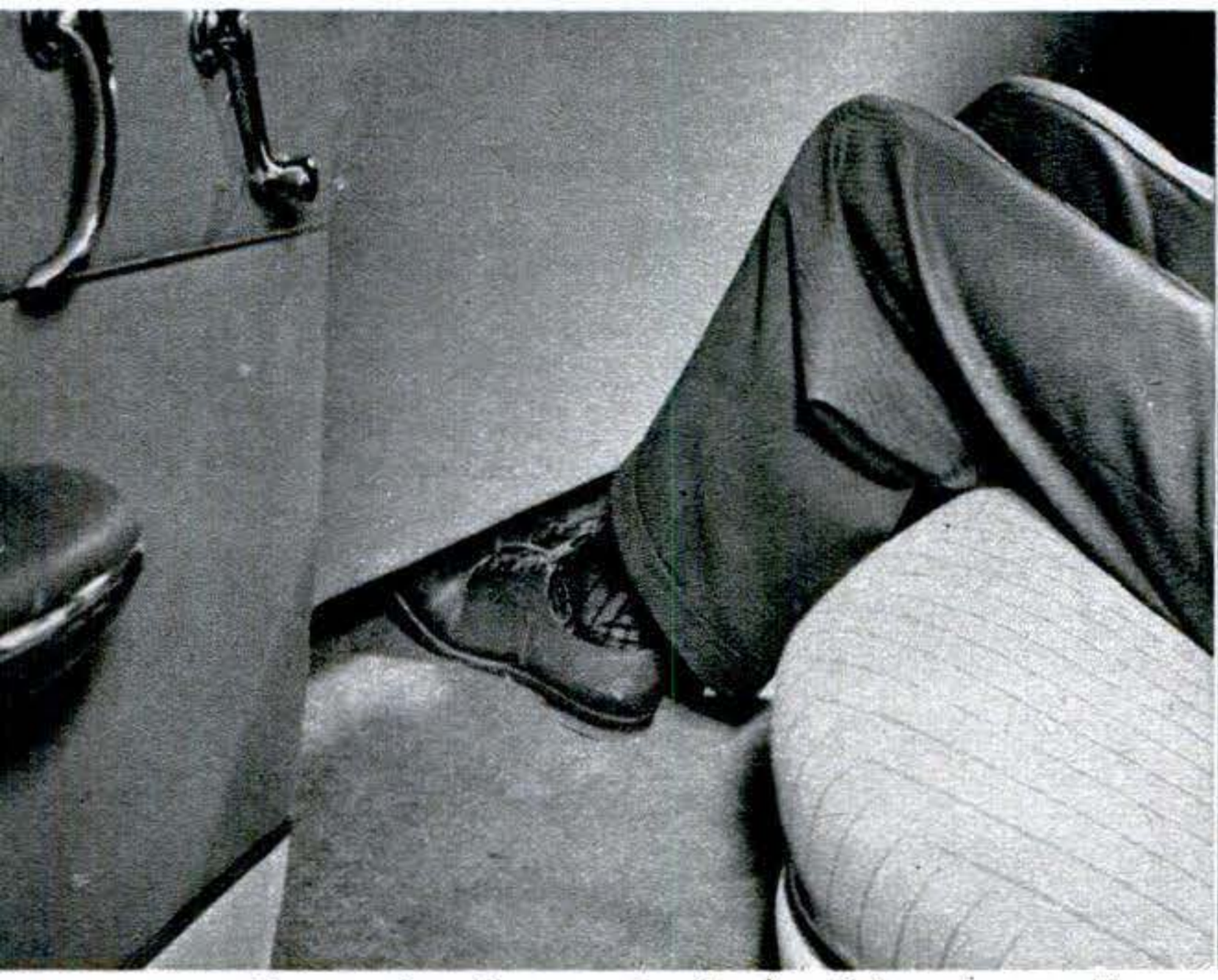


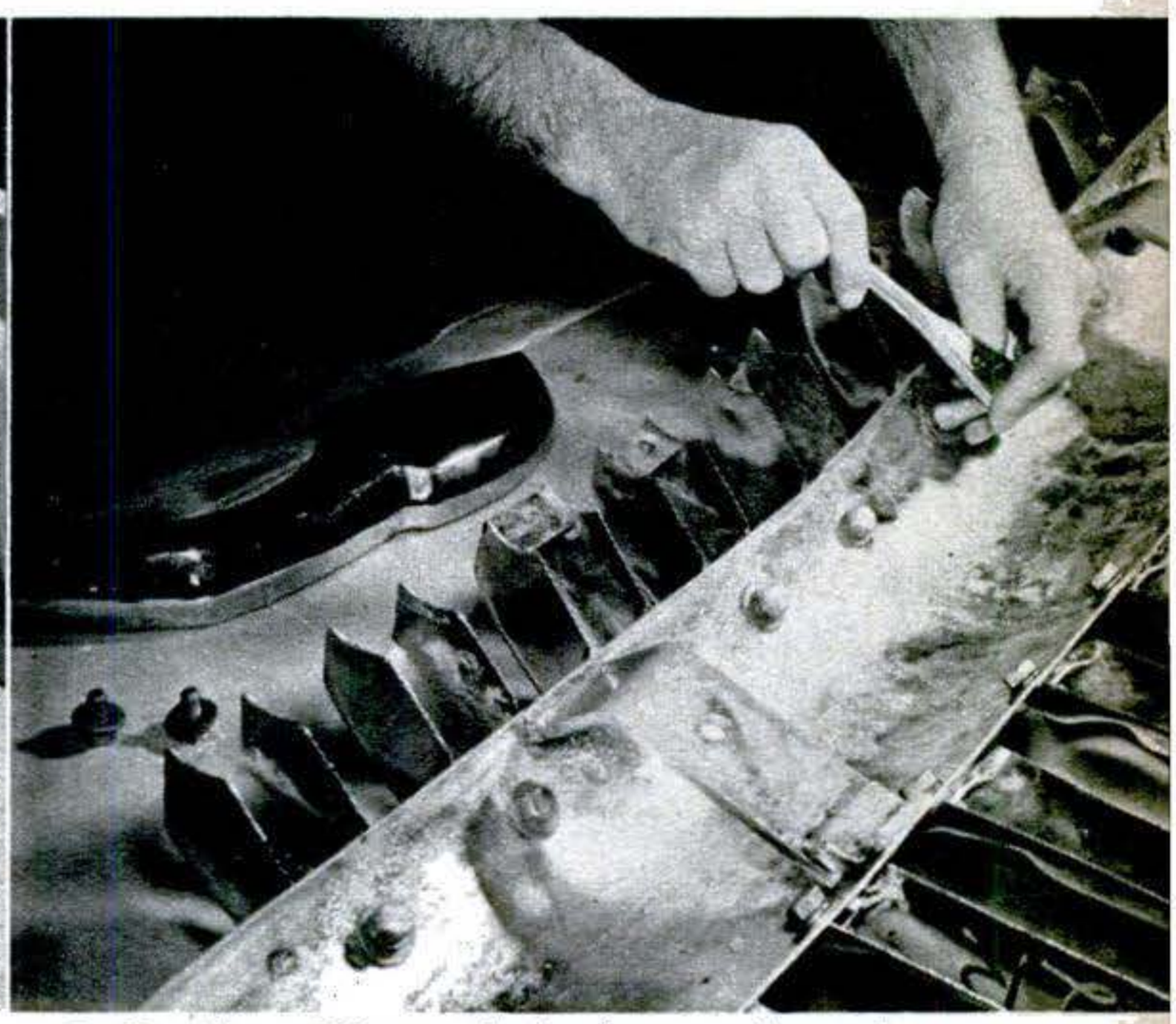
New door catch is push-button operated. Handle blends into door panel, has no open end to catch clothing. Baffle inside keeps out dampness so lock won't freeze in the winter.



Arrows point to two of four large slots in bottom of door to drain off moisture and prevent rusting. All of car's interior and exterior surfaces are covered with anti-corrosion primer.



Space for feet under back of front seat allows sufficient rear-seat leg room when front seat is pushed back. Car's interior width at shoulder level is 57.1 in. in front, 53 in. in rear.



Grille "teeth" are bolted onto front bumper separately so they can be easily replaced when damaged. Bomb-shaped parking lights (not shown here) are recessed to reduce breakage.

COMPARISON OF BUICK MODELS

	ROADMASTER	SUPER	SPECIAL
CURB WEIGHT	4,362 LB.	3,947	3,797
WHEELBASE	125.75 IN.	121	121.5
LENGTH	214.12 IN.	209.38	204
HP.	150 @ 3,600 R.P.M.	115*	110*
COMP. RATIO	6.9 TO 1	6.6**	6.3**

*120 WITH DYNAFLOW.
** 6.9 WITH DYNAFLOW.

The man responsible for the first of the Buick Specials, back in 1936, was Harlow H. Curtice. Then general manager of the Buick division, he put out a car factory-priced at $885, weighing, in its sedan version, 3,360 pounds. Pounds are important in the automobile-manufacturing business — normally, the lower the weight, the lower the price.

Buick had sold 43,000 cars in the depression year of 1933. It was in eighth place in national sales. By 1938 it had shouldered its way into fourth place with sales of 166,000, and it kept on going up. It was the Special that made Buick (and Curtice) top bracket—today Curtice is executive vice president of General Motors.

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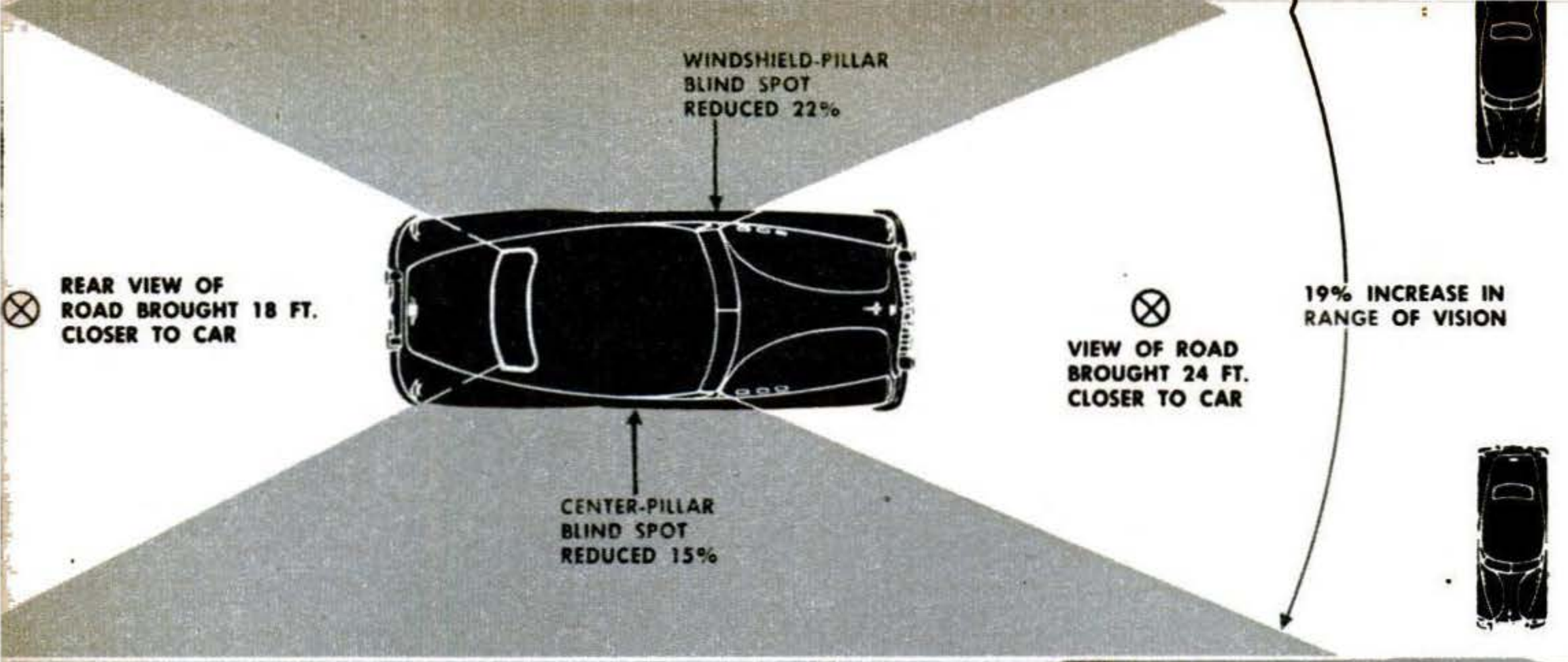


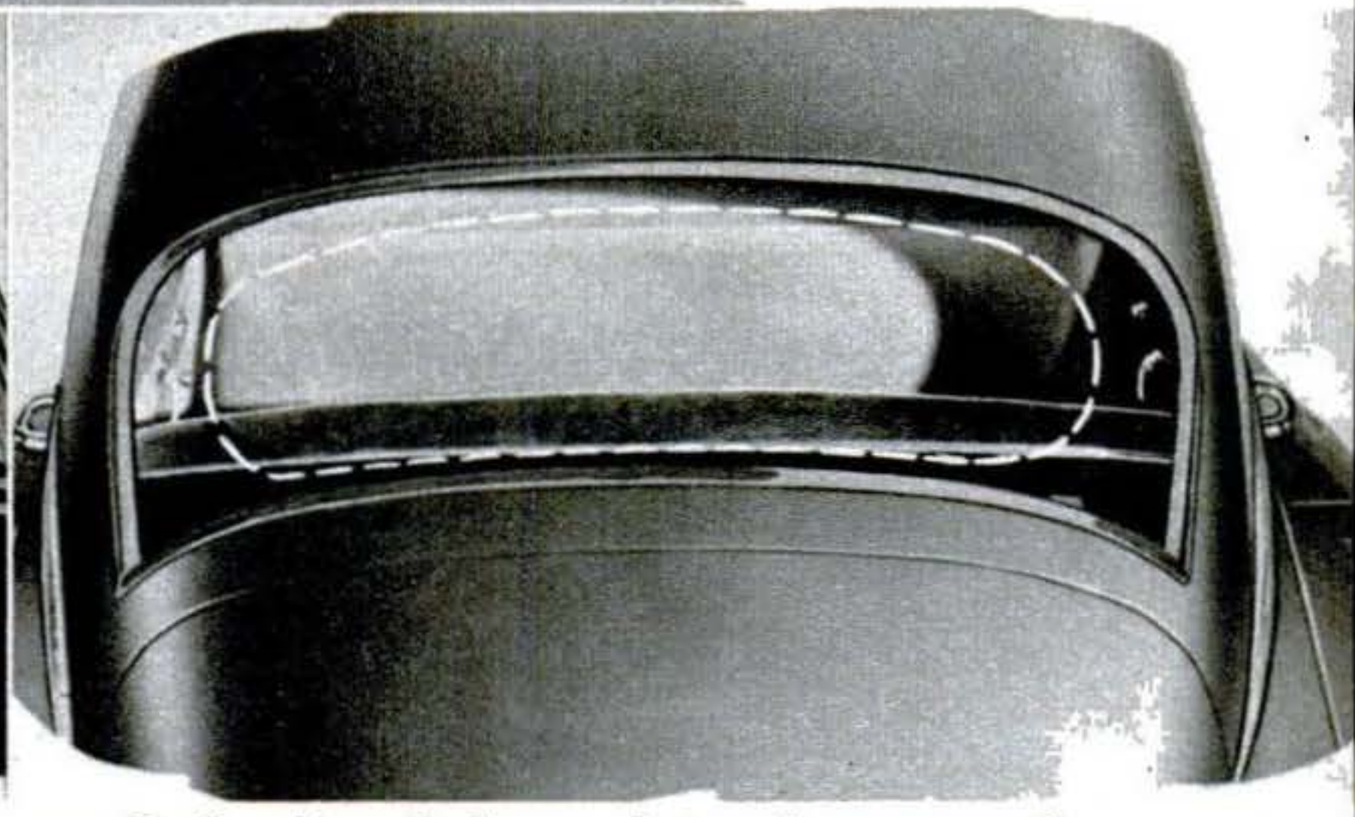
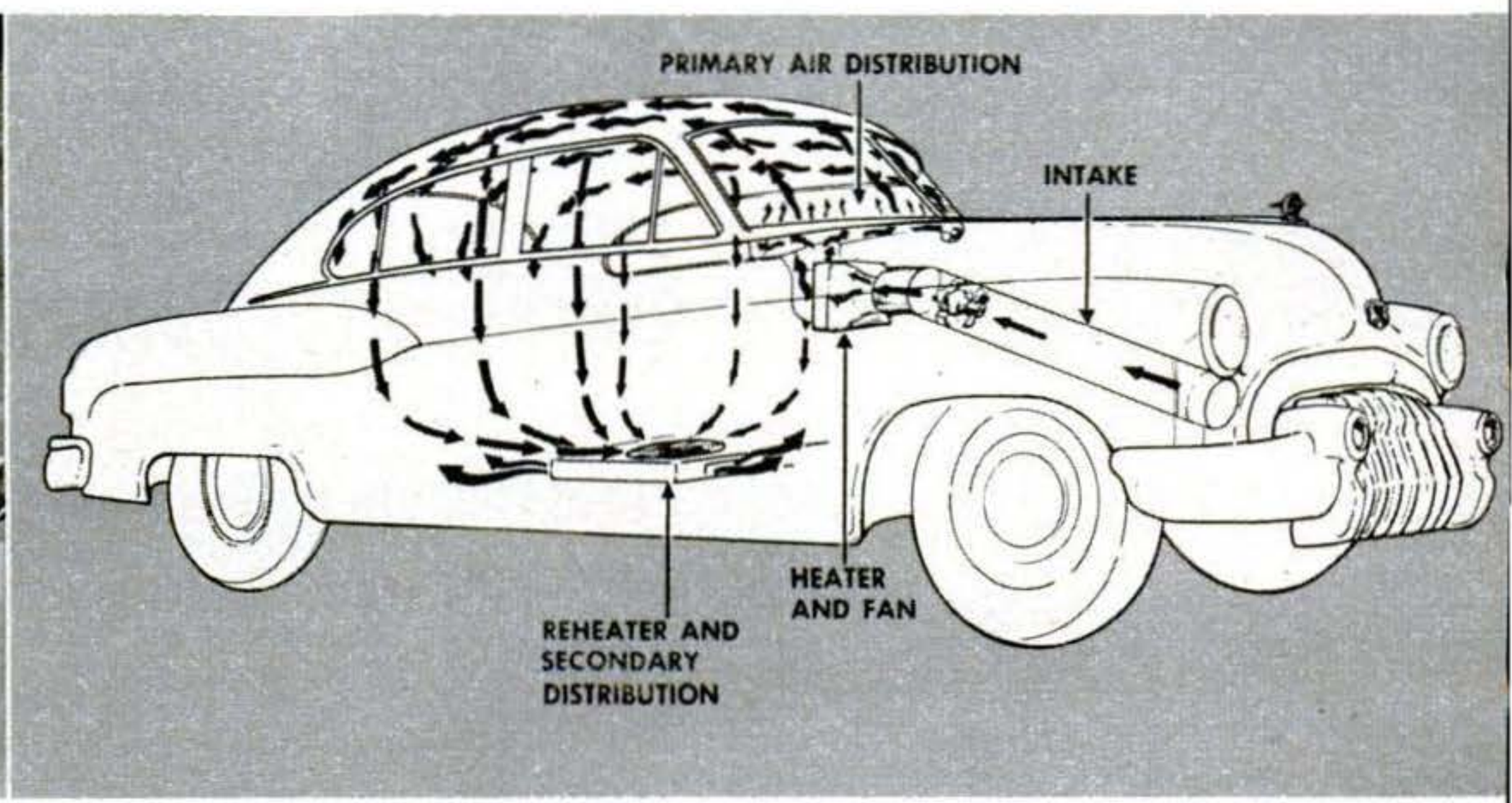


Diagram at top shows new Special's improved visibility. Moved-back windshield pillars give driver 265-foot-wide view at 100 feet ahead of car. Broken lines in lower photos show areas of old front and rear windows. New windshield is increased 48 percent; rear window, 56 percent.

The new Special weighs somewhat more than its granddaddy, and its price, like all prices these days, is a lot higher. But it is still the hottest thing Buick has on the salesroom floor. The big plant in Flint, north of Detroit, is producing at the rate of 400,000 cars a year.

Ivan Wiles, Curtice's successor as Buick's general manager, commented to POPULAR SCIENCE that only the "big three" were now below Buick's price-per-pound of automobile. Watch him. He may shade the figure to make another Special give Buick another boost. END



Reheater under front seat (left, above) recirculates car's air to keep feet warm in winter.

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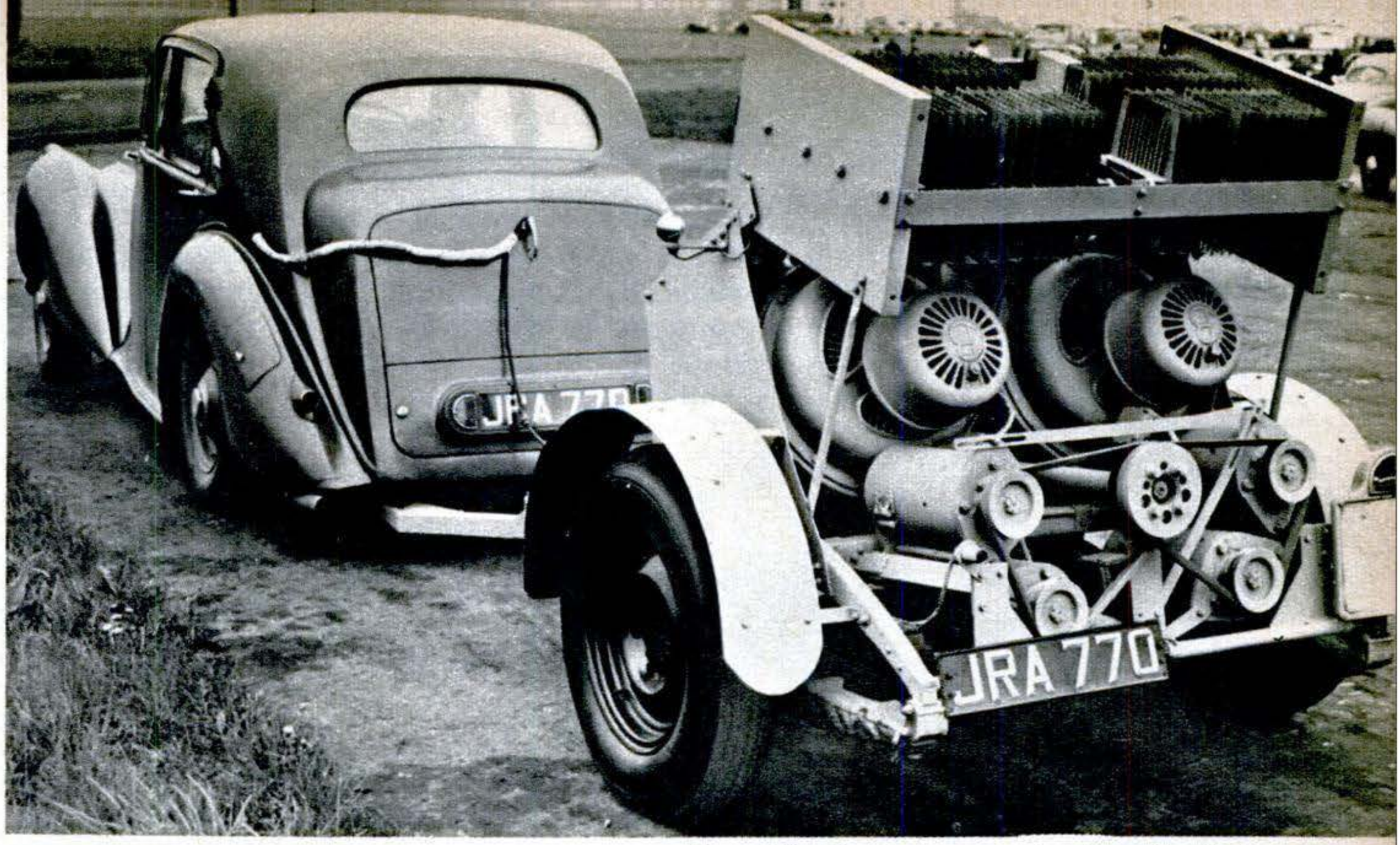
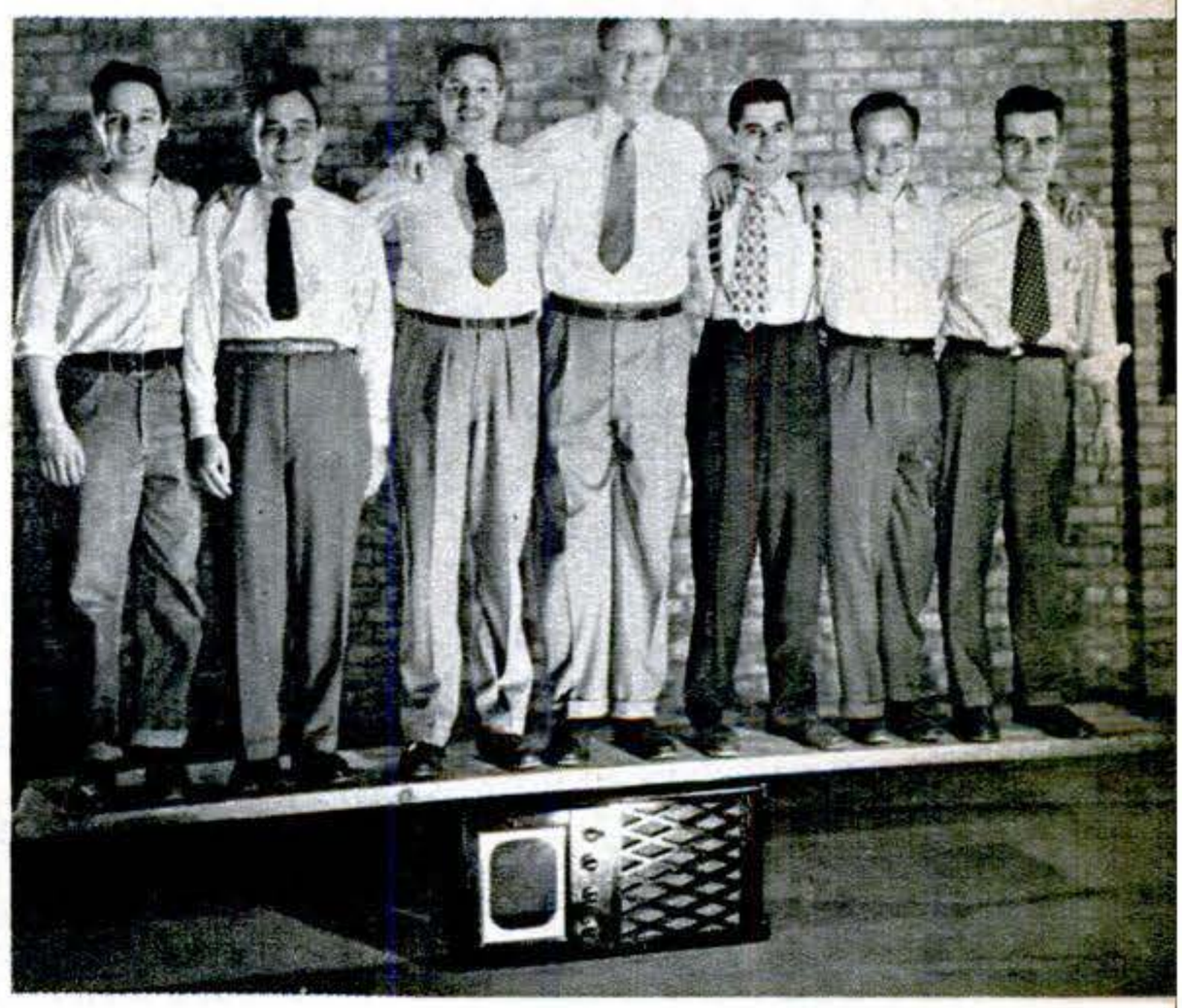


Trailer "Treadmill" Tests Cars

THIS British Bentley is deliberately dragging its feet so engineers can test the effects of prolonged acceleration. Since acceleration normally occurs quickly, the only way to get a good long look at what happens is to hold the car back while it tries to go faster. Here's where the trailer comes in. Its wheels turn dynamometers that provide any desired drag to simulate hill-climbing or high speeds while still keeping the car at low speeds and on level ground. Made by Rolls-Royce, it can absorb 100 hp. when actually going only 30 m.p.h. while engineers leisurely study cooling-system efficiency and elusive engine noises.

BB-Proof Lens Protects Eyes

"SAFETY-GLASS" lenses that even an air rifle can't shatter are now available for spectacles. In the demonstration above, a marksman sent a BB shot right through an ordinary lens, but could only crack the safety lens. Intended mainly for wear by children, the new lenses are a glass-plastic sandwich, like auto windows. American Optical Co. makes them.



Plastic Makes Strong TV Cabinet

SEVEN men demonstrate the strength of this new all-plastic cabinet for a console television set by standing on it. The cabinet is molded in a single, 35-lb. piece by a huge shell-case press originally built for the Russian Government. Molded Products Corp., Chicago, produces it for a new 10-in.-screen Admiral set that retails for about $250.

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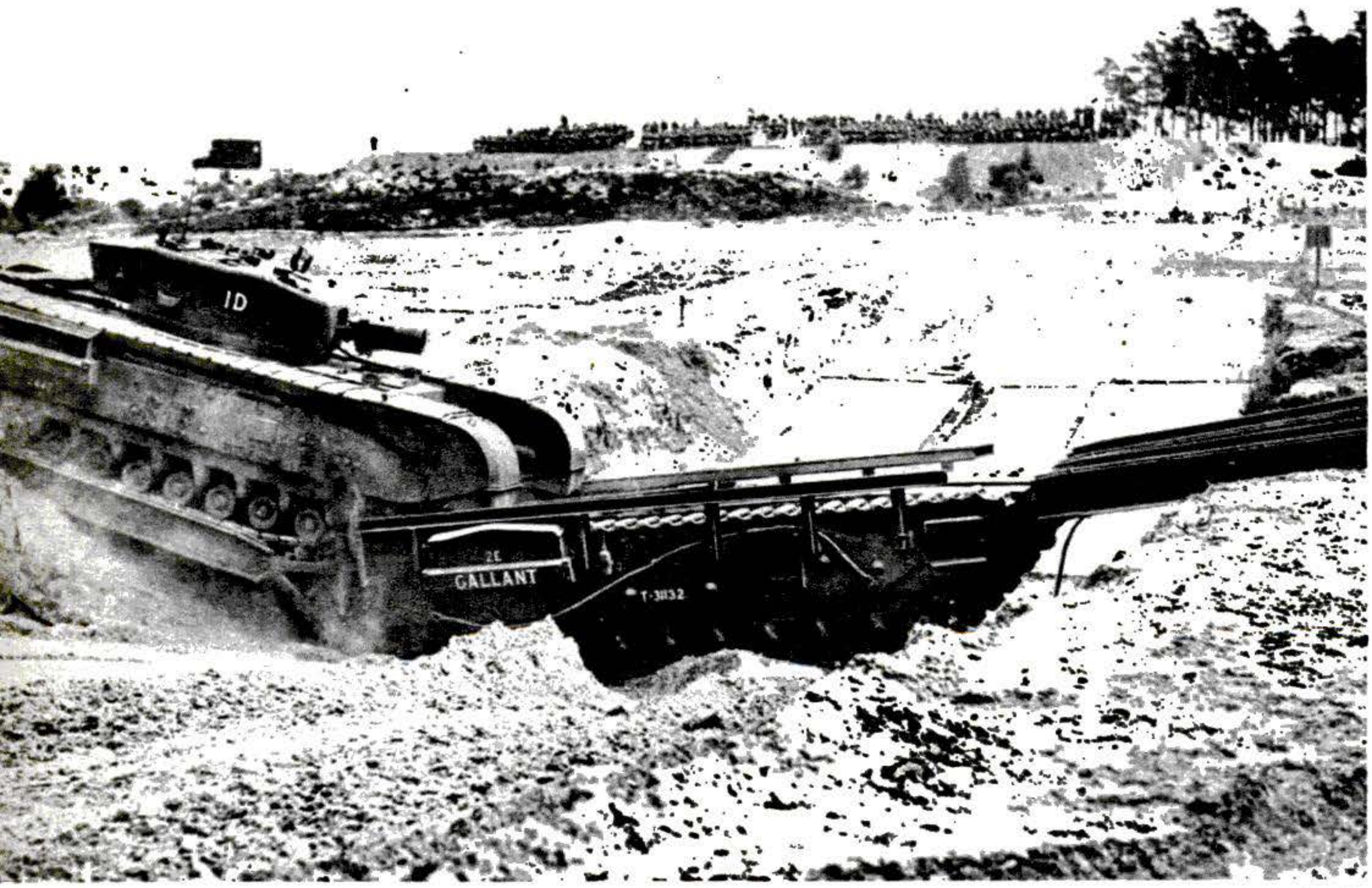
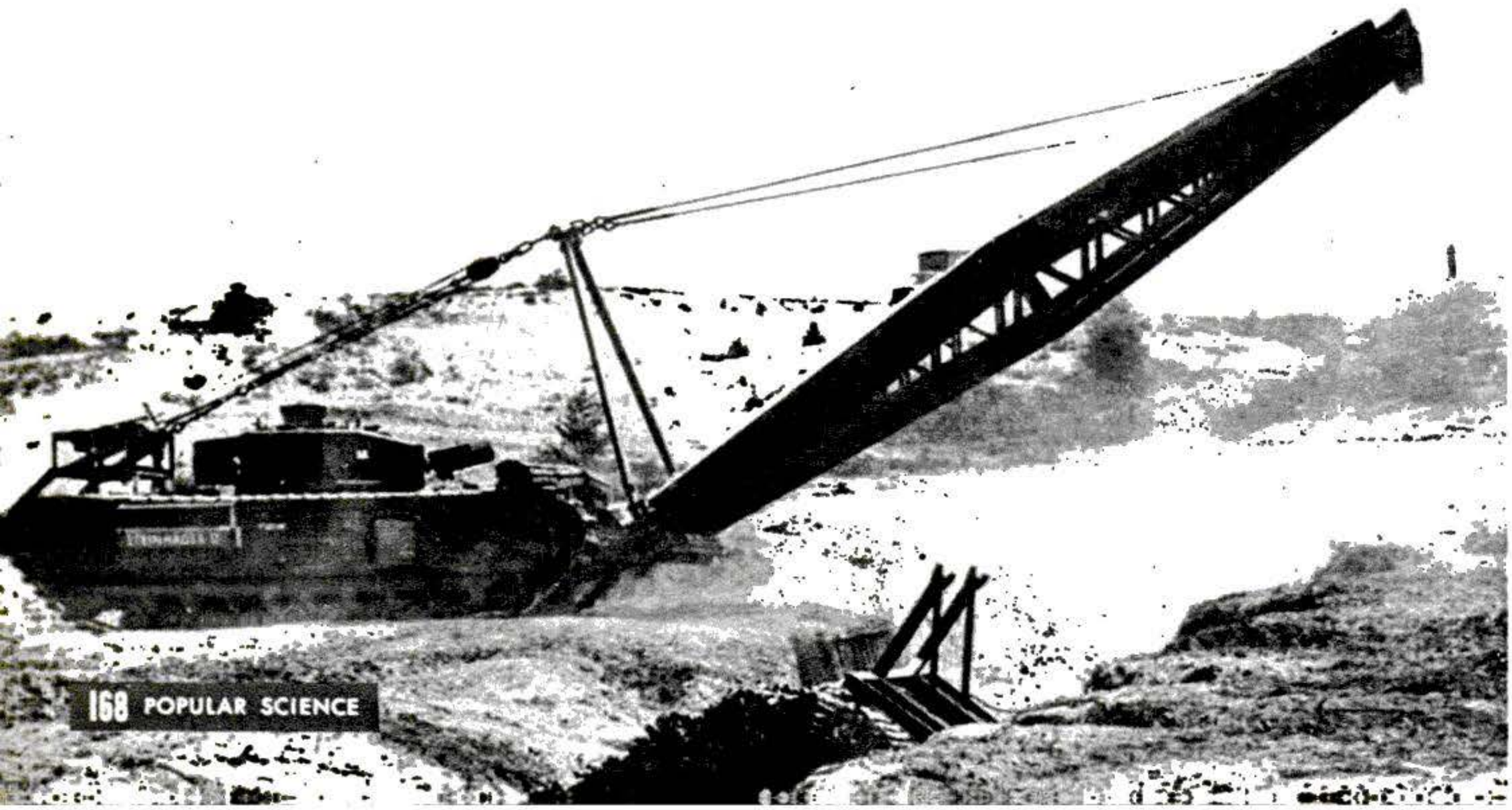
New Tanks Hurdle Ditches

PLAYING leapfrog and laying portable bridges, new British tanks demonstrated their ability to hurdle ravines and excavated "tank traps" in recent maneuvers. One turretless type with ramps at each end fits itself into a gap up to 15 feet wide—and assault tanks then rumble to the attack over its back. Another model carries and lays a girder bridge, over which heavy tanks can cross a ravine as much as 30 feet wide.



Tanks play leapfrog, as a big one rides over back of new model that crouches in a ditch.

Bridge-laying tank emplaces a portable girder span, enabling heavy vehicles to cross ravine.



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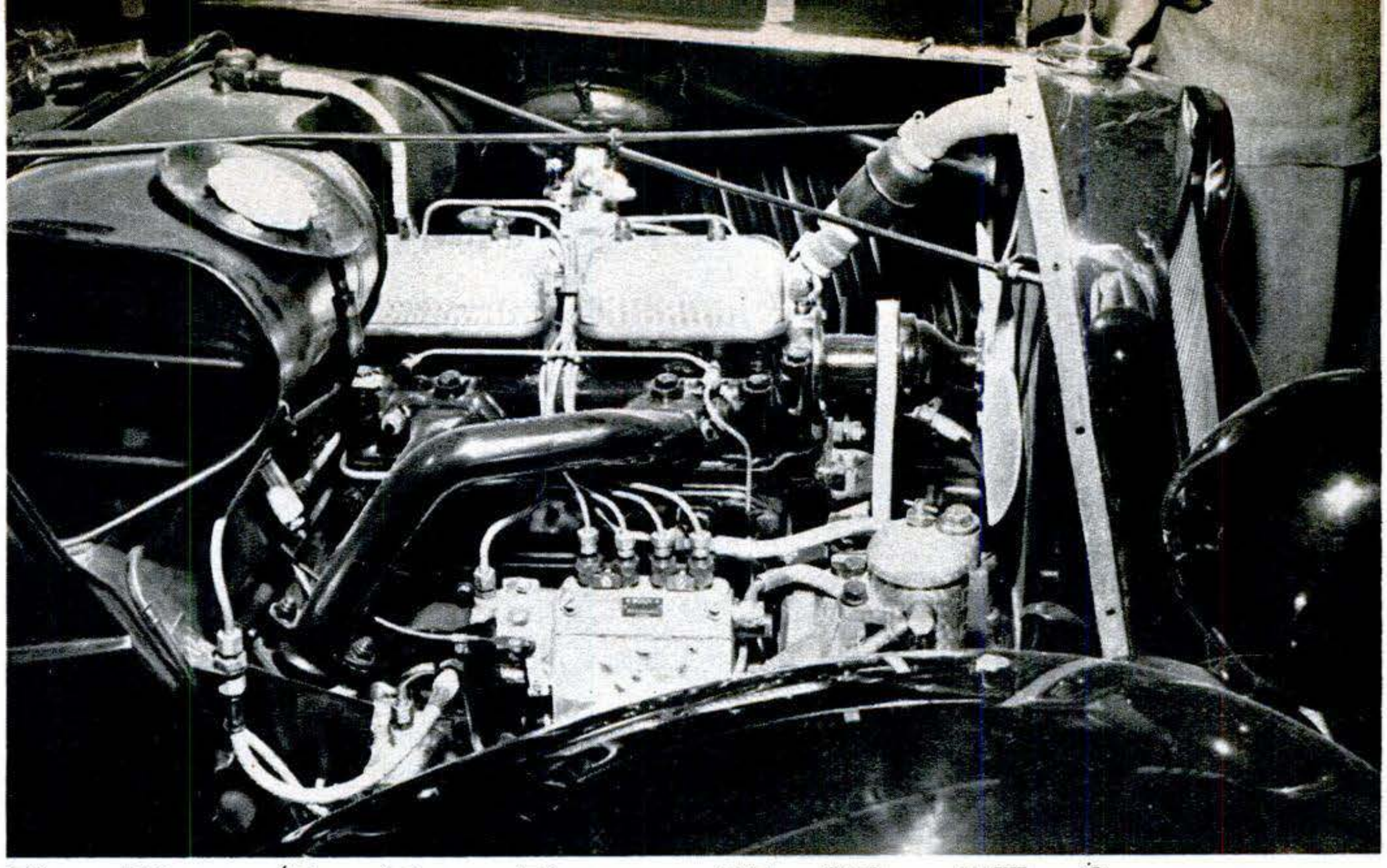
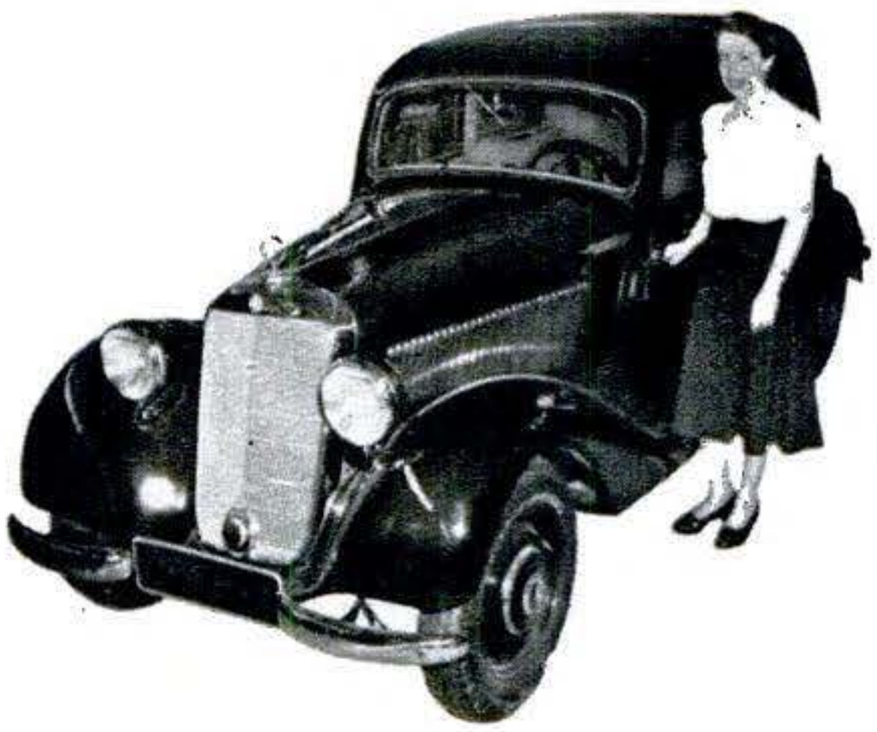


New Mercedes-Benz Powered by Diesel Engine



ALTHOUGH trucks and buses long have used Diesel power, manufacturers of passenger cars have been slow in following. One problem has been to eliminate the heavy throb of the truck-type Diesel, and another to get an adequate speed range. Engineers claim to have licked these troubles in the Mercedes-Benz shown here. The 38-hp. engine, according to the company, will turn out 40 miles per gallon of Diesel fuel, which costs much less than the 60 cents to $1 a gallon European gasoline brings. Top speed is said to be 60 m.p.h. The car, shown at a recent trade fair in Hanover, Germany, will export for about $2,000.

Cruises on Land or Water

HENRY J. FARRAR, former aircraft worker, gives his newly built land and water car a workout on a Miami, Fla., street at right. Below, he puts the novel machine through its paces on Biscayne Bay. Farrar, who designed and built the 20′ craft, reported that both tests were successful. Attachments on the tractor type wheels convert them to paddle wheels for use in water. On land, the autoboat is steered by the single front wheel.

Smoky exhausts and expensive repair jobs usually go hand in hand, but the smoker a state cop drags in needs only the quick treatment.

Gus Fixes a Traffic Rap

By Martin Bunn

TROOPER Jerry Corcoran likes action. And that was exactly what he hadn't been getting for the past few weeks. All the action he'd seen recently was his regular patrol. Corcoran was bored. In fact, he was more than bored. He was irritated.

He sat his parked motorcycle just off the highway at an intersection, watching the late afternoon traffic outbound from the city. An old sedan, trailing dense smoke from its exhaust, rolled down the side road. It was almost to the highway when Corcoran noticed it. The driver barely slowed for the stop sign, slamming into second and wheeling into the main road toward the city.

Corcoran kicked the starter and roared

"Fill it up with high test and make it fast. I'm in a hurry," she snapped. Sutter hurried over after Stan.

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in pursuit. He sped through the acrid smoke and drew abreast of the sedan. The driver, a thin-faced young man, stared straight ahead. When Corcoran sounded the siren, the startled driver jerked his head around and slowed his car. The trooper waved him to the shoulder of the highway. Jerry parked his motorcycle in front of the sedan and walked back. The driver had his head out the window.

"What's the matter?" he asked excitedly. "I wasn't going too fast."

"Let's see your registration and driver's license," Corcoran ordered. The young man fished them out of his wallet with shaking fingers and handed them over. "Henry Sutter," the trooper read.

"What's the matter?" Sutter repeated, apprehension in his voice. "I haven't done anything wrong. I'm in a hurry. I've got to get to the city right away."

"Your registration and license seem to be in order," Corcoran said, "but running that stop sign back there was certainly out of order."

"What stop sign? I didn't see any sign."

"Where you turned into the highway."

"I just didn't see any sign," Sutter said. "All I remember seeing at that intersection was a lot of bushes and weeds."

"And besides," the trooper went on, "there's a law in this state against driving a car that's in such bad mechanical condition that it's a menace to other traffic."

"What do you mean—a menace to other traffic?" Sutter demanded indignantly. "There's nothing wrong with this car. It's nine years old but it runs okay."

He Didn't Know It, He Says

"I said," the trooper repeated heavily, "that your car is a menace to other traffic. It's throwing enough smoke out of the exhaust to pass for a regulation Army smoke pot."

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"This car never smokes," Sutter said flatly.

"Get out and look for yourself," Corcoran told him.

Sutter climbed out of the driver's seat, walked around back, and returned with a puzzled expression on his face.

"It's never done that before. Something must have gone wrong since I left home."

"I've heard that one before," Jerry commented.

"Honestly, I didn't know it was smoking," Sutter said. "It wasn't when I backed out of the garage. I got out to see if the trunk was locked, and there wasn't any smoke."

Jerry gave the young man a long, hard look. The trooper knew very well that the stop sign was partly obscured by brush. He didn't want to press that point too much, but he didn't want Sutter to think he'd forgotten it.

"Maybe I'm a sucker," he told Sutter, "but I'm taking your word about the smoke."

"Then I can go now?" Sutter's face brightened.

"No," Corcoran said. "There's still that stop sign and, anyway, you can't drive this smoking car. You'll have to get a garage car to tow you in."

"A garage car!" Sutter almost screamed. "I can't take the time now. It's getting late. Everything depends on me getting to the city. Everything!"

Corcoran froze up again. "That car's a menace," he snapped. "If you try to drive it, I'll arrest you. Make no mistake about that."

Sutter pleaded and argued so earnestly that Corcoran finally weakened. He said it would be all right if Sutter followed him to the nearest garage and had the smoking fixed right away.

A couple of miles down the highway they reached the Model Garage. Stan Hicks stepped to the shop door as they pulled into the drive.

"Hi, Jerry," he called. "Know there's a smoke screen following you?"

"I want this car fixed right away," Sutter cut in. "I've got to get to the city."

"Right away?" Stan laughed. "How long do you think it takes to rebore cylinders and install new rings?"

"New rings!" Sutter gasped.

"I never saw a car smoke like that if the rings weren't shot," Stan said.

"What's up?" Gus Wilson asked, stepping up beside Stan.

Sutter cut the ignition, got out, and told Gus the story of the smoke.

"The car was all right when you left home," Gus summed up, "but started smoking after you'd driven awhile?"

"That's right."

"Could be rings," Gus said, "but I doubt it. They usually show up gradually."

Just then a convertible whizzed into the drive and jolted to a stop at a gas pump. Stan stepped over with his best smile when he saw the driver was a pretty girl.

"Fill it up with high test and make it fast. I'm in a hurry," she snapped.

Sutter hurried after Stan. Jerry strolled after Sutter. When the girl saw Sutter, her mouth tightened.

"There's something wrong with my car," Sutter told her abruptly. "It may take some time to fix it. You know we're after you. Will you take me to the city?"

"Here's your money," the girl said to Stan. She turned to Sutter: "I have to pick up Mr. Johnson, and anyway, if you're late, it'll be just too bad." Then the convertible was gone.

Who Murdered Staunton?

"Check the plugs, Stan," Gus told him when the old sedan was in the shop.

"Number one's oily," Stan reported in a couple of minutes. "Number two is oily, too, but not as bad. The rest are okay."

Gus walked to his workbench. He rummaged through a drawer, picked up two small pipe plugs, and returned to the car. Sutter was pacing up and down nervously. Stan heard him talking to himself and edged over to Corcoran.

"You'd better watch that guy, Jerry," he advised. "He's talking to himself about somebody being dead and some money being gone. And he told that girl in the convertible, 'we're after you.' "

"I thought there was something queer about that guy," Corcoran muttered.

Sutter had stepped to an open window and was staring out. Jerry drifted to the water cooler near the window. He heard Sutter say: "He's dead. Staunton's dead. In my apartment. And the money's gone. That girl's got it."

Just then Gus called to Sutter.

"Watch this," Gus said, pointing to the fuel pump. Gus disconnected both ends of a copper tube that ran from the pump to the intake manifold. Then he screwed the pipe plugs into the openings in the manifold and pump. "Start her up," Gus told Stan.

The engine ran smoothly and no smoke came from the exhaust.

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"So it wasn't the rings," Stan said, much puzzled. "But what was it?"

"If you were familiar with this model," Gus explained, "the cause of the smoke wouldn't be tough to guess. The fuel pump is a dual unit. It's both a fuel pump and a vacuum-booster pump. The line from the windshield wiper runs to the vacuum side of the unit. Another line from that unit goes to the opening in the manifold. It keeps the vacuum up on the wiper when manifold vacuum is weakened by tromping on the throttle or when you're pulling hard on a hill."

"But what's that got to do with the smoke?" Sutter asked.

"The vacuum-pump diaphragm developed a leak," Gus went on. "This allowed oil to be pulled from the crankcase and fed into the intake manifold. From there the oil went into the first two cylinders, where it burned, causing smoke."

"I see," Stan put in. "Disconnecting the line stops the oil and the smoke."

"Can I drive it now?" Sutter cut in impatiently.

"Sure," Gus said, "but the windshield wiper won't work until a new diaphragm has been put in the vacuum pump and that line has been reconnected."

Under Arrest

"You can fix it tomorrow," Sutter said. "I haven't got time now." He started to get in the car, but Corcoran caught his arm.

"You're under arrest."

"Under arrest?" Sutter yelped. "What for?"

"For driving an unsafe vehicle," Corcoran told him. "That'll hold you for now. What about Staunton? He's dead in your apartment. And the money's gone. What about that?"

The trooper expected Sutter to cringe in dismay. Sutter didn't. Instead, he started to laugh. He laughed until tears were running from his eyes.

"I'm sorry," he said at last, "but it is funny. Staunton's dead and the money's gone."

"All right, all right," Corcoran said peevishly. "Let's go to the station house and see how funny that is."

"Keep your shirt on," Sutter said between chuckles. He reached in a pocket and pulled out a printed folder and several typewritten sheets. "That business about Staunton being dead and the money being gone are just lines from a play we're putting on tonight."

The trooper took the folder and read aloud: "Twenty-fifth Annual One-Act Play Tournament. Final round. Avon Little Theater presents 'Another Way Out' . . . Richard Davis, a lawyer . . . played by Henry Sutter."

Sutter pointed to one of the typewritten sheets. "Here are my lines . . . Staunton's dead, and so on. Satisfied?"

"No," Corcoran said, "I'm not. What about that girl? You said you were after her."

Sutter laughed again. "I meant that our play went on after hers. She directs the company that's in the finals with us. She wouldn't take me to the city, figuring that if I didn't get there her company would win by default when our play didn't go on."

"Well, you better get going," Jerry grinned wryly. "How wrong can I get?"

"Afraid it's too late now." Sutter glanced at the clock.

"Suppose the girl were late, too?" Corcoran asked.

"They're on first. If they start late, then I can make it."

"Who'd she say she had to pick up?"

"A Mr. Johnson," Sutter said. "In Newtown."

"Then she's got to pass that same stop sign," Jerry grinned.

"That's right," Sutter agreed.

"On your way," Corcoran said. "I better go talk with a girl about a stop sign she isn't going to see." END

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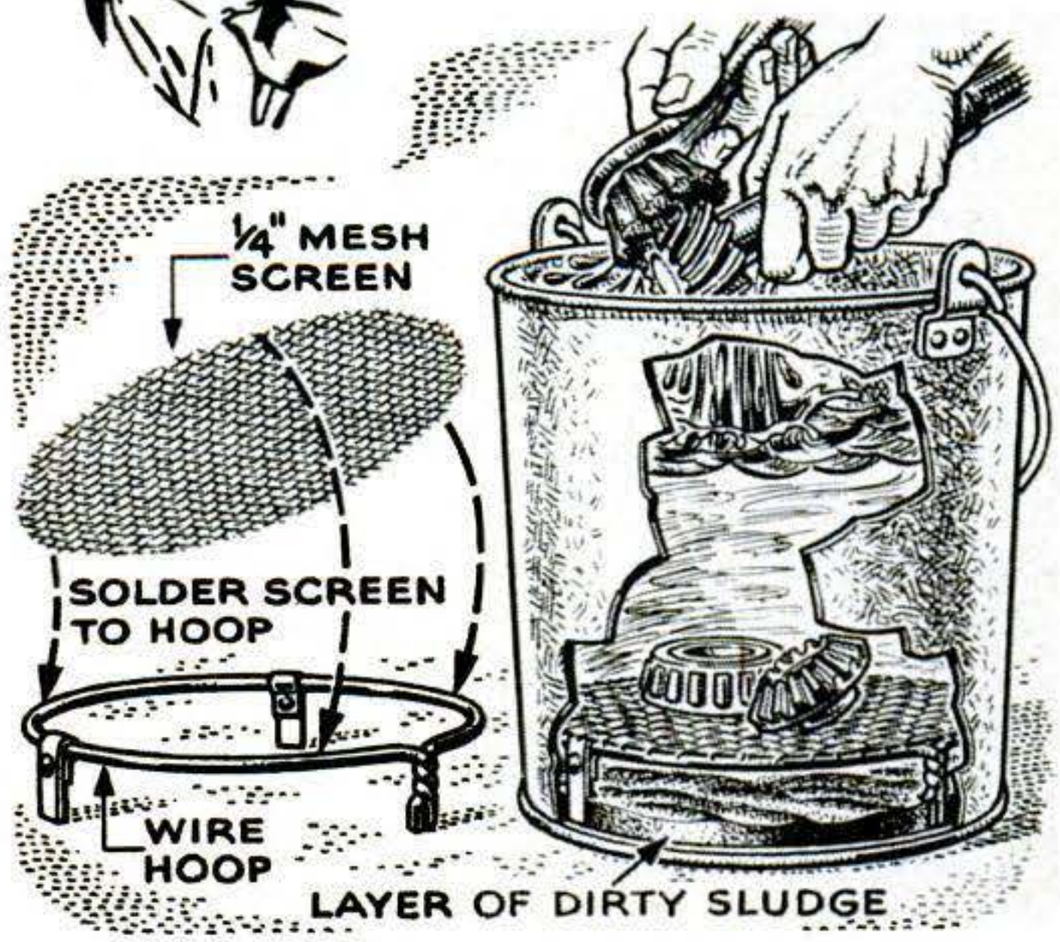
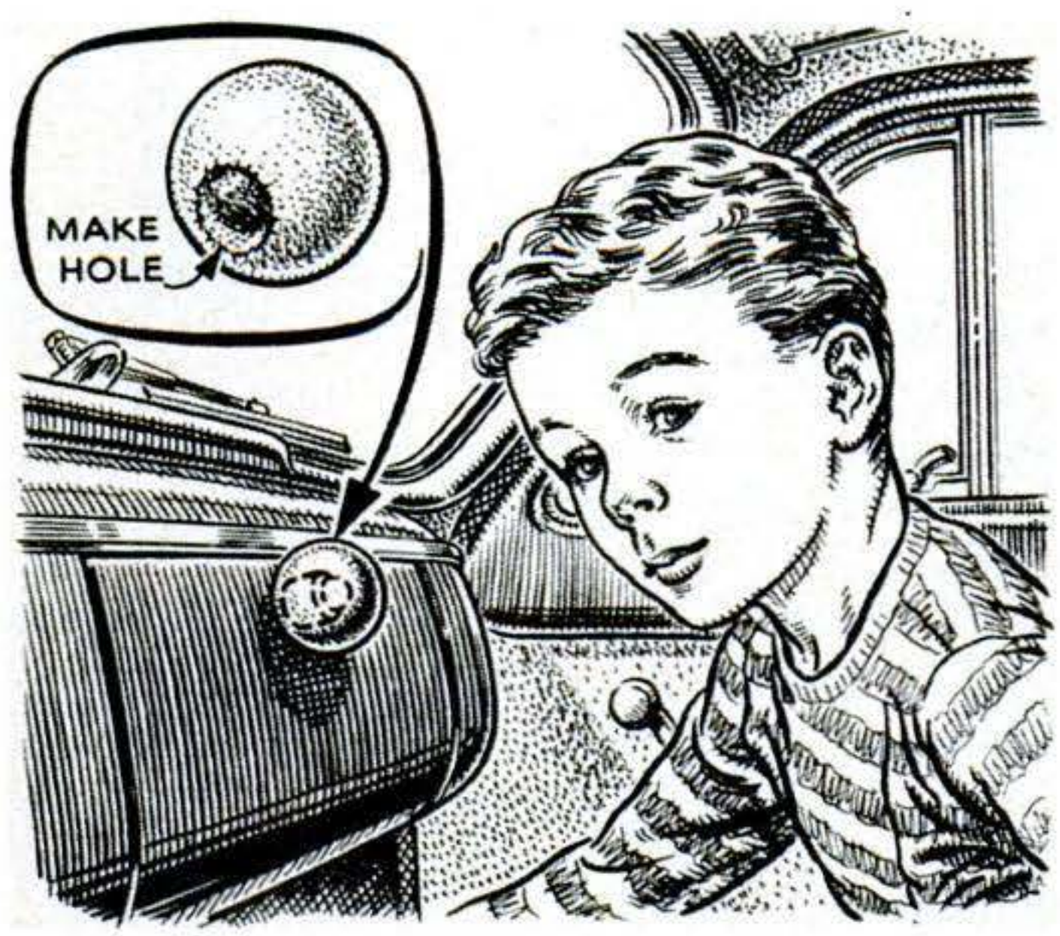
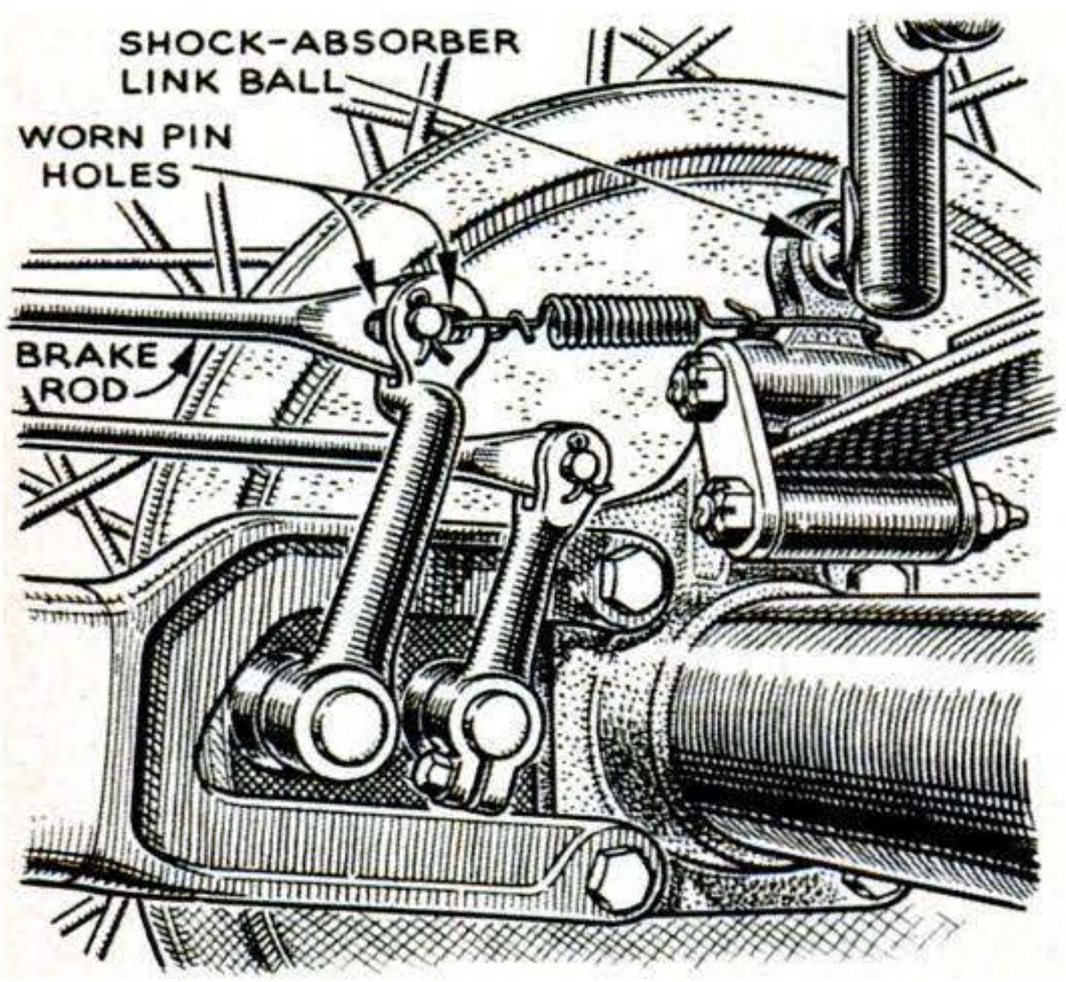
Hints from the Model Garage



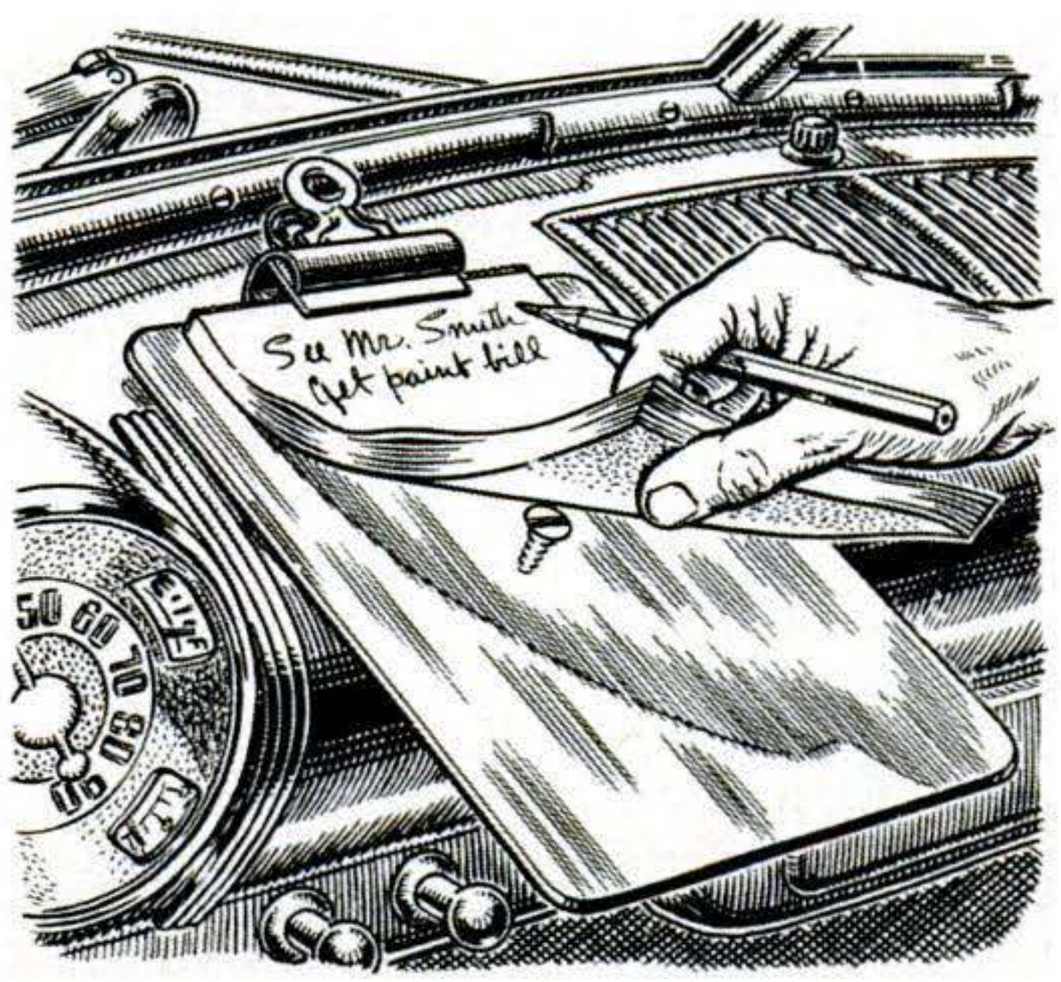
Solvent Stays Clean. Harry Morse, of Oakland, Calif., suggests putting a screen in your parts-cleaning bucket when you're taking down a unit. It lets dirt settle to the bottom and keeps it from being stirred up while you're brushing parts.



Ball Protects Children. Knobs or handles on the dash can give youngsters a bad bump on sudden stops. Sponge-rubber balls fitted over the protruding parts reduce this hazard. A dab of gasket shellac in the hole will attach the ball securely.



Spring Holds Brake Rod. Model A Ford owners sometimes have trouble keeping the mechanical brakes in adjustment because of worn linkages. In such cases, it's probably advisable to install new linkages if available. But you might like to try the idea illustrated above, suggested by J. O. Troemner, of Madison, Wis. The spring takes up the slack that results from the worn pin holes, preventing the brake from dragging when off.



Make Notes While You Ride. A note pad is often a useful thing to have at hand in a car, especially if you are apt to be forgetful. S. D. Laing, of Burrton, Kan., made provision for one in his car by mounting a 4" by 7" piece of heavy sheet aluminum on the dash at a convenient writing angle. A single self-tapping screw holds the piece of aluminum. A pad of note paper is clipped to this, and a pencil is kept in the clip.

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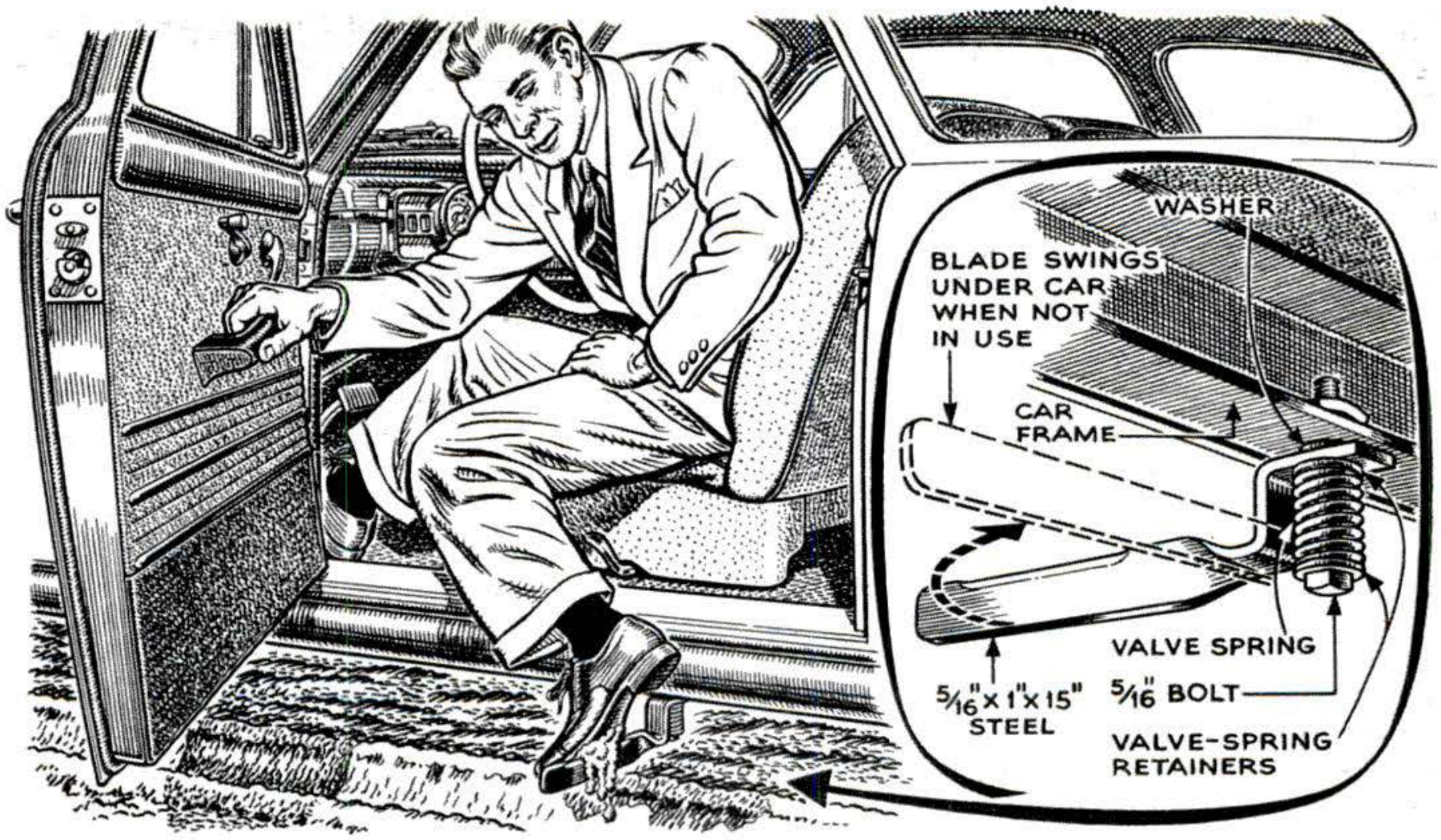
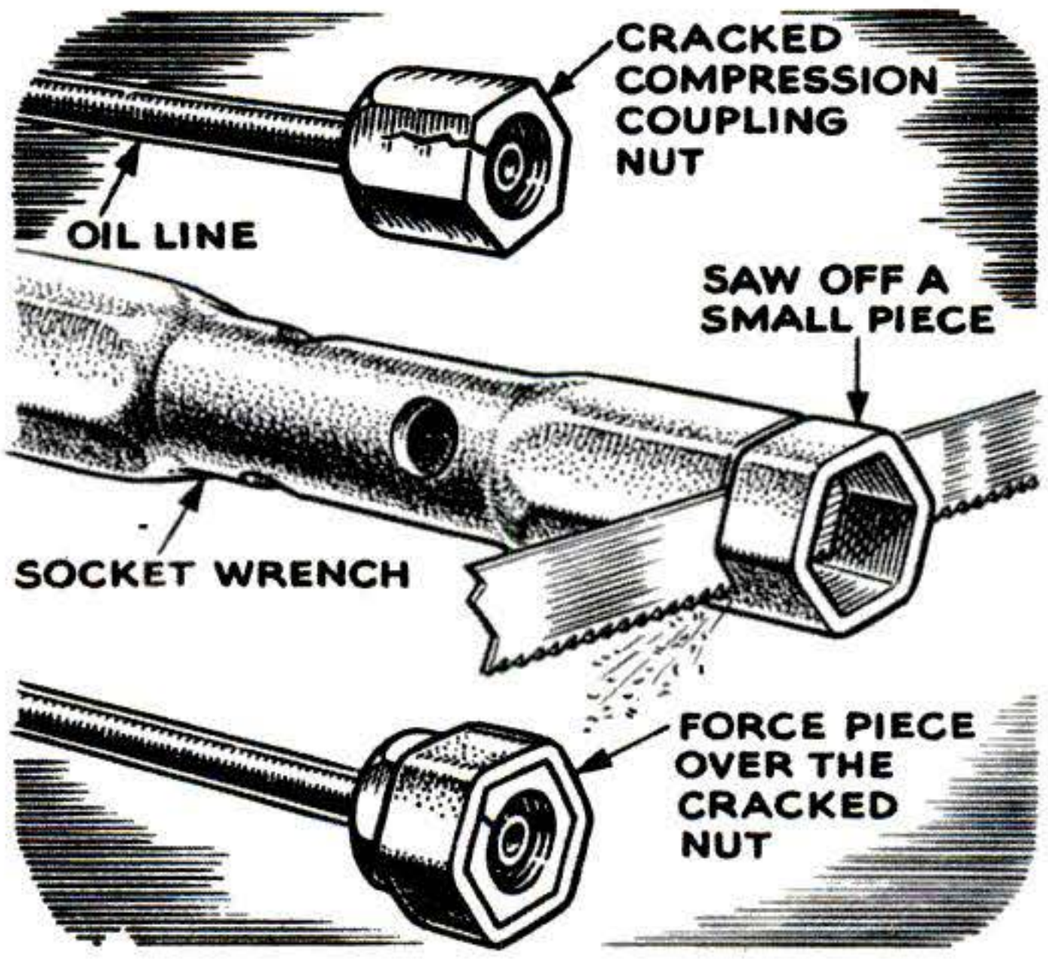
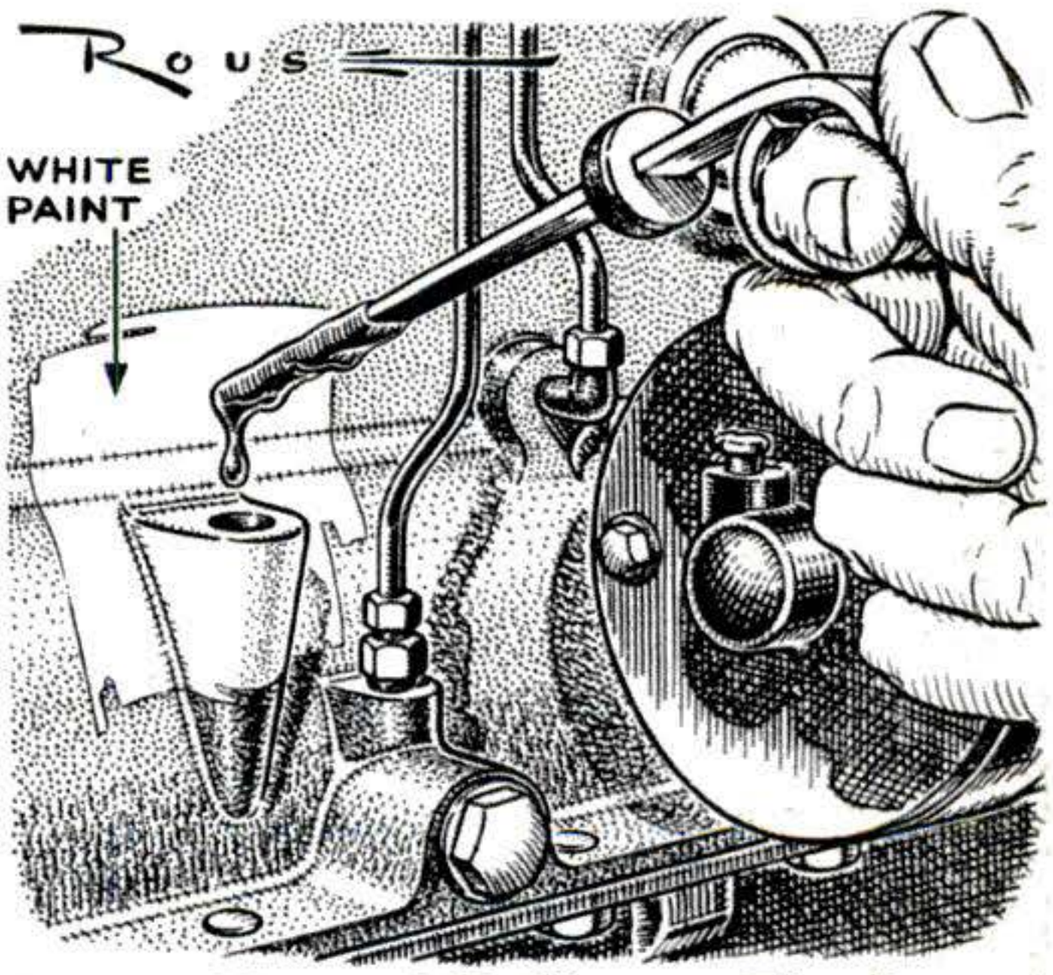


Scraper Cleans Your Shoes. A shoe scraper conveniently mounted will help keep the interior of your car cleaner. The one shown was designed and built by members of the auto mechanics class at the senior high school in Midland, Mich.

Dimensions were chosen to suit a new Hudson, an existing hole being used to mount the scraper. By changing the dimensions, you could adapt the scraper to other makes. It might be best, however, to bend up a strip of tin first as a template.



Socket Repairs Oil Line. When an oil line began to leak because of a cracked coupling nut, Norman EnHolm, of Lake Mahopac, N. Y., made an effective repair in this way. After disconnecting the union, he selected a hex socket wrench that would not quite fit on the nut. He then hacksawed a piece off the socket, squeezed the cracked nut together with a clamp, and drove on the collar. It stopped the leak.



Keep Your Oil Clean. The dirt and grit that gets into your crankcase through the dipstick hole may not amount to much, but why take a chance? Scrape the accumulated oil and dirt away from the opening occasionally so you won't shove it inside by accident. At the same time, apply white enamel around the hole. It will make future cleaning easier and help you locate the hole to replace the dipstick.

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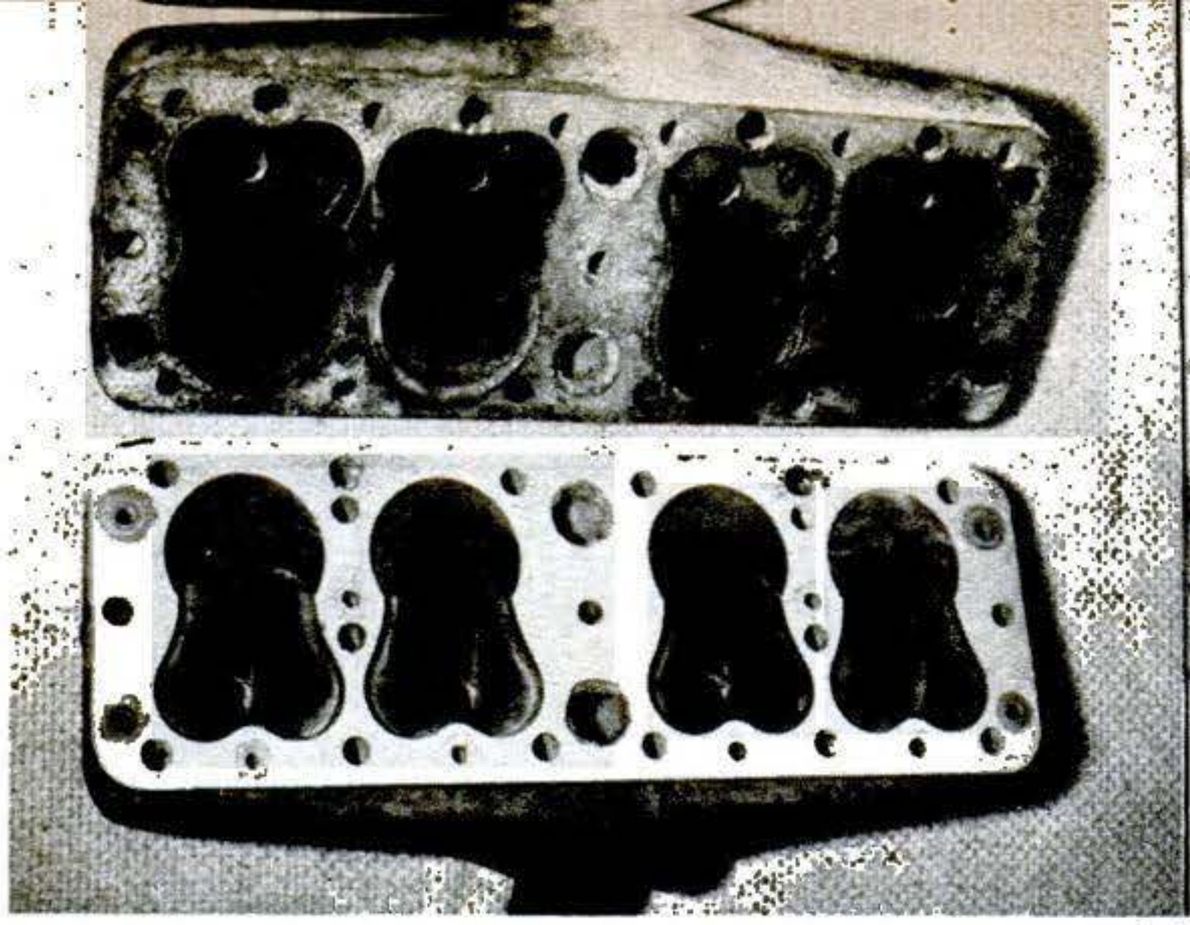
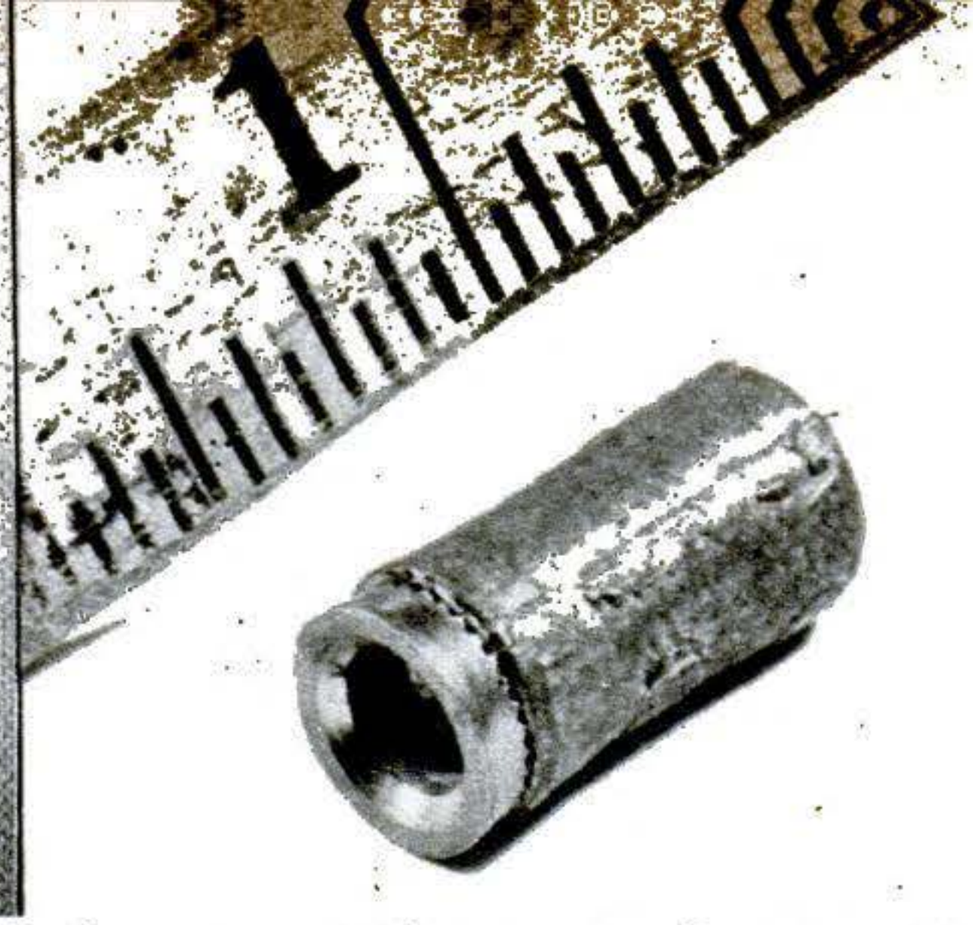
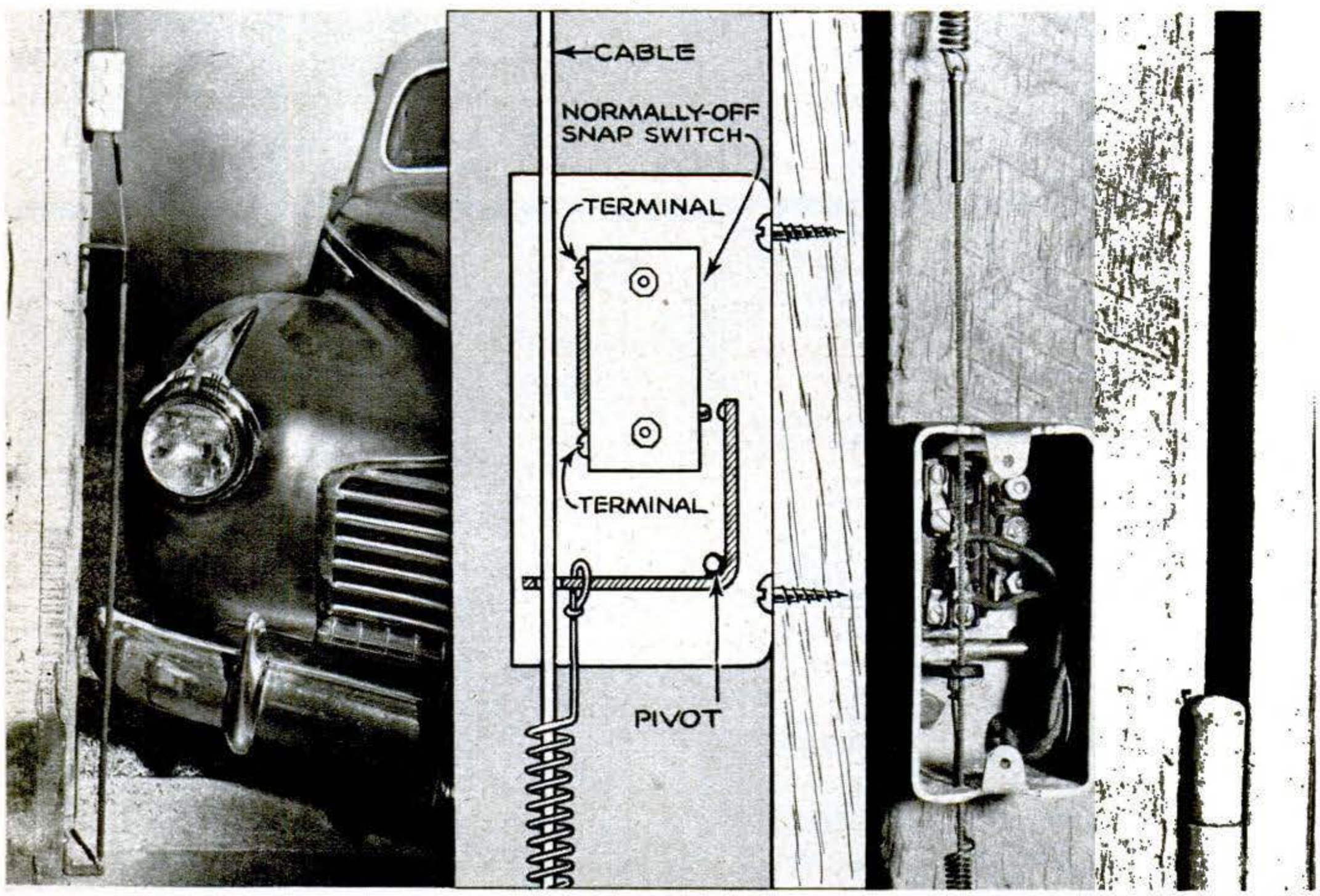




Anchors Repair Aluminum Head

IF THE water-circulating holes in an aluminum cylinder head have eroded away, lead-jacketed anchors used to set bolts in masonry (see upper right) will make a repair. Directly above, at the top, is an eroded head and below it one fixed in this manner.

Pick an anchor a trifle larger than the hole. If the largest available is too small, wrap with a strip of sheet lead. Cut the anchor short so it won't extend too far into the jacket. Clean out loose material from the eroded hole, but don't smooth it. Drive in the anchor until almost flush and peen over to fill all cracks. Then dress down flush by rubbing the head over a large sheet of emery cloth laid face up on a flat surface.—*A. J. Hurst, Milford, Ohio.*



Bell Guides Car into Garage

MANY garages are so placed that you must turn a sharp curve while entering or leaving. W. E. Nichols, of Santa Monica, Calif., solved the problem as above.

When the bumper strikes a spring-loaded cable stretched parallel to one side of the doorway, a pivoted lever attached to the cable turns on a snap switch, ringing a door-bell mounted in the garage. This shows the driver he is in the correct position to proceed without striking the doorway on either side. A similar system could also be used to warn that you are so close as to risk scraping the fenders on the right-hand side.

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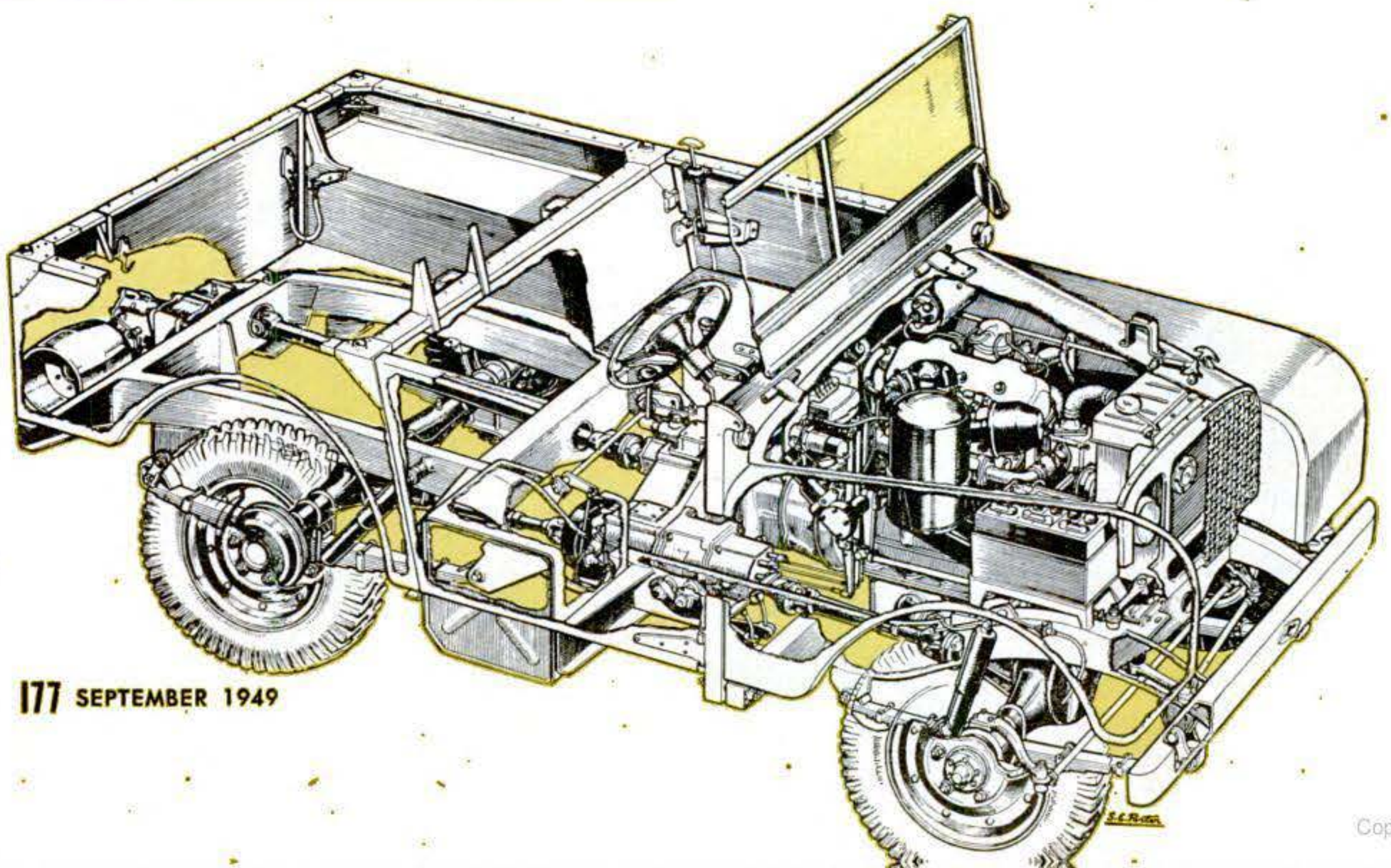
Rear Deck of Special Car Raised Hydraulically

NORMAN E. TIMBS, auto designer of Van Nuys, Calif., stands at the rear of his $10,000 ultra-streamlined car. The chassis is of tubular construction with independent rear suspension by means of a swing axle. Although the wheelbase is 117″, the 2,300-lb. car is 210″ long. A late-model Buick engine behind the driver's seat powers the streamliner. The hydraulically lifted rear deck covers engine, gas tank, and spare wheel.

British Land-Rover Built for Brush Country

DESIGNED for highway travel as well as work in rugged country, this vehicle built by the Rover Co., Ltd., a British concern, is powered by a 4-cylinder, 97.29 cu. in. engine of 50 hp. The transmission includes a transfer assembly that gives both two- or four-wheel drives and eight forward speeds. There are power take-offs at the rear and in the center of the chassis, and a winch at the front. The all-welded frame has five main cross members. Side members are 6″ deep at centers and 3″ wide throughout. Wheelbase is 6′8″ and overall length 11′. Tires are 6 by 16. Pictured here without a top, the Land-Rover® can be fully enclosed. The body is aluminum reinforced with steel.



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Blinker Also Gives Work Light

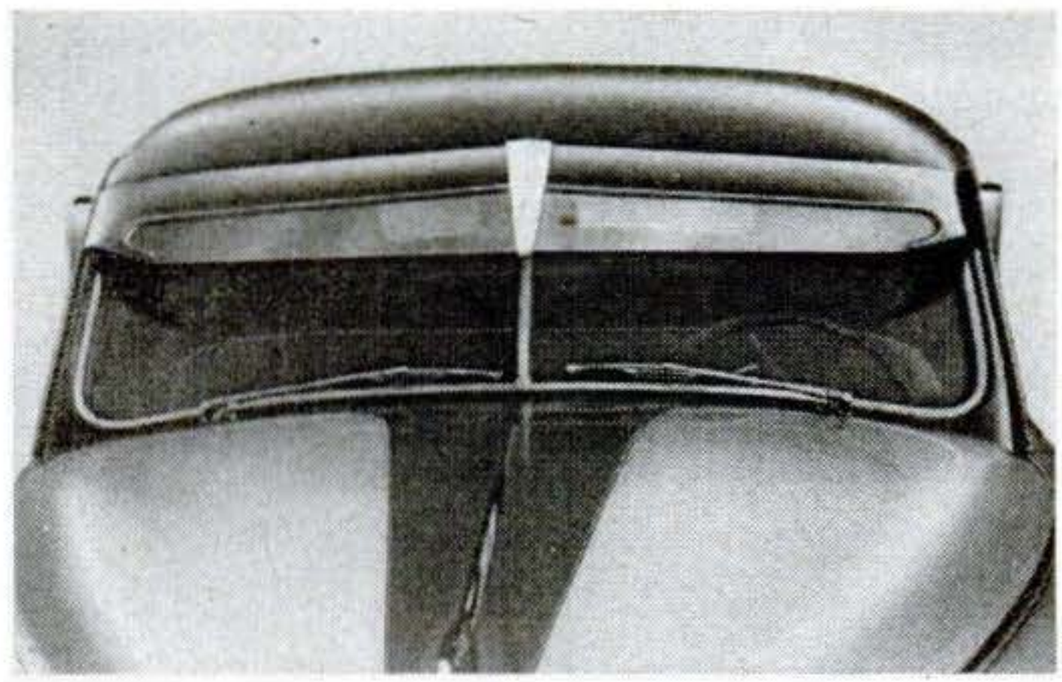
A TRAFFIC-warning signal and work light are combined in this repair lamp, made by Alden Products Co., Brockton, Mass. A blinking red signal faces traffic, a continuous white light illuminates the work area. For use, it's opened as above and a 17′ cord plugged into the cigar-lighter socket. Closed, it fits into the glove compartment.

New Fabric Tops Convertibles

FABRIC woven of Fiberglas® yarns coated with Vinylite® resins is now being marketed as a material for covering convertible tops. Developed by Cordo Chemical Corp., Norwalk, Conn., the fabric doesn't stretch or shrink and can be cleaned with soap and a damp cloth. It's available in black, tan, maroon, light gray, and dark gray.

Visor Cuts Day or Night Glare

BLUE-TINTED glass on this new automobile visor is said to offer glare protection from both sunlight and headlights. In addition, the transparent area allows you to see overhead traffic signals without neck-craning or crouching. Made by Knowles-Fisher Corp., Gowanda, N. Y., to fit most makes of cars, the visor is attached to the rain gutter with inconspicuous clamps. It retails for about $30 and can be installed in a few minutes.

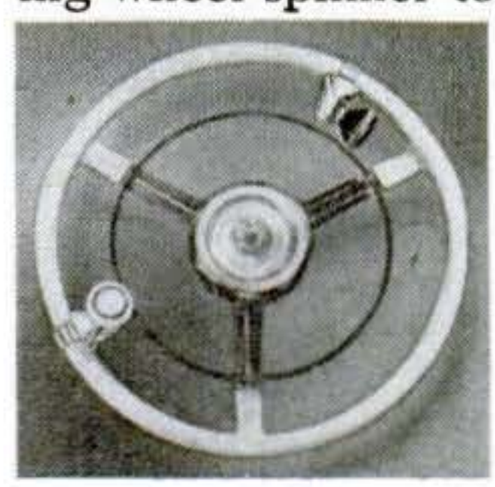


Telescoping Clothes Rack Wedges Inside Auto

MADE of two telescoping steel tubes, this clothes tree is kept in position by pressure against the roof and floor. Williams Mfg. Co., Anaheim, Calif., prices it at about $4 in black finish, $7.50 in chrome. The notched arm holds 20 hangers.

Spinner Twists Out of Way

PRESSING a small button allows this steering-wheel spinner to be flipped down if you don't want to use it. It clicks up again just as easily. In either position, the knob clears the horn ring. The spinner is made by the Santay Corporation, of Chicago.



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With dime-store equipment, you can map contour lines of your land. Page 180.

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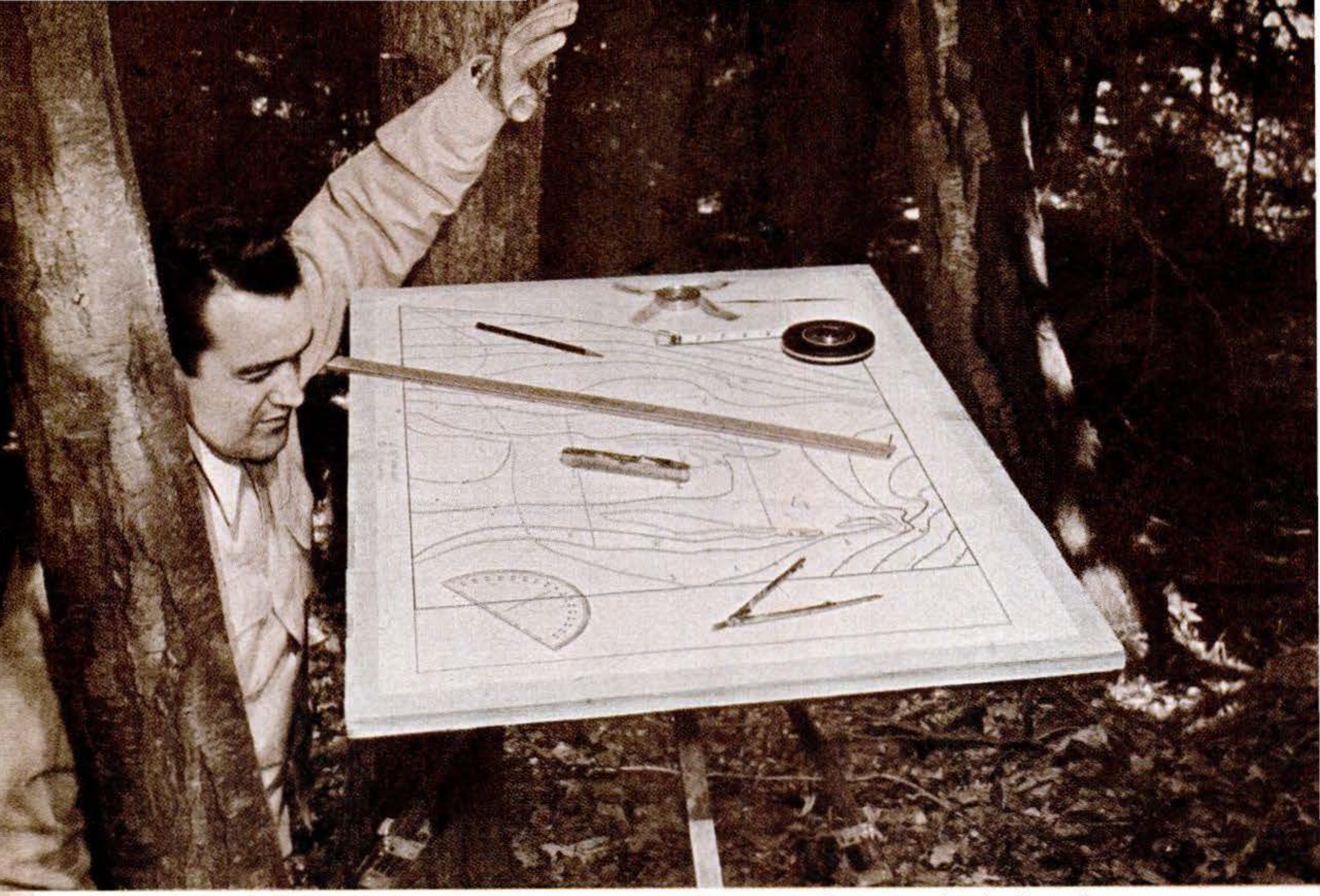

Here's all you'll need to buy to make a contour map. Spirit level, drawing compass, protractor, ruler, and pencil came from dime store. A 50′ engineer's tape is shown, but plainer one will do. Note magnetic compass, also from dime store, taped to board at far edge.

How to Make Contour Maps

By following this simple method, you can create a map of your land that will help you make the most of its features.

By Sheldon M. Gallager

PS photos by W. W. Morris

FITTING a house, or any other man-made feature, to a piece of land is like buying a suit of clothes—the tailor must know your special dimensions and contours before he can make it fit right. Only there's no trying a house on for size, no taking it back for a second fitting. It's got to fit the first time.

To do this, whether you're planning a home, adding a wing, putting in a driveway, or just laying out a back-yard rock garden, you've got to know how the land lies—literally and accurately. If you don't, you may find yourself trying to do a bulldozer's job with a garden trowel.

That's why PS decided to test out a simple method by which you can make a contour map of your land that will show its every hill and hollow, every curve and cranny. Such a map will help tell you where to spot your buildings, how to make the most of the land's natural features, and exactly how much digging or filling may be required.

To put the method through its paces, we selected the roughest, toughest land we could find—a rolling, rocky, hillside acre, complete with steep slopes, ragged outcrops, dense underbrush, and even a sheer 15′ drop. If the method worked here, it would work anywhere.

Called the plane-table method, it's perhaps the simplest of all surveying techniques. It requires no expensive instruments, no complicated mathematics, and no special know-how. You make the map in the field, watch

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it grow right before your eyes as you work.

As the name implies, you use a table to make your map on, drawing in the contours as you go. Those contours are simply imaginary lines connecting points of the same elevation. Your job is to find the points and connect them. Here's where the table comes in. The idea is to set it up level at a point of known elevation and then sight other points of similar elevation from the table.

You'll need a helper—a rodman, in surveyors' lingo—to hold a graduated marker pole while you make your sights. The pole should be at least 6′ long and marked off into inches. To make it more readable at a distance, you can paint the 1′ sections alternately black and white. A small circle of cardboard, divided into four equal segments alternately painted red and white, is thumbtacked on as a sighting target. If you want to get real fancy, cut a small hole in the center so the rodman can read the markings accurately.

Next you'll need something to let you sight a straight line from your table to your rodman's target. In its fancier versions, this is called an alidade. Commercial alidades come with telescopic sights, built-in levels, and vernier adjustments. But a 24″ ruler with a brad hammered in at each end near the edge will do the trick as well—and can be bought for two bits. Sight along the ruler, lining up the two nailheads with your eye, and there's your alidade. Always keep the same end of the ruler toward you.

To sight a contour point from the table, you first direct the rodman to walk up and downhill in a radius from the table with the target pinned to his marker pole at the same height as the table. A measured cord from the pole to the table keeps the rodman at the same distance at all times—provided he keeps it taut. When the target is level with your table, you draw in the sight line on the map along the ruler's edge. This gives you the rodman's direction. Scaling his distance on this line then gives you his exact location. This represents a contour point of the same elevation as the table's.

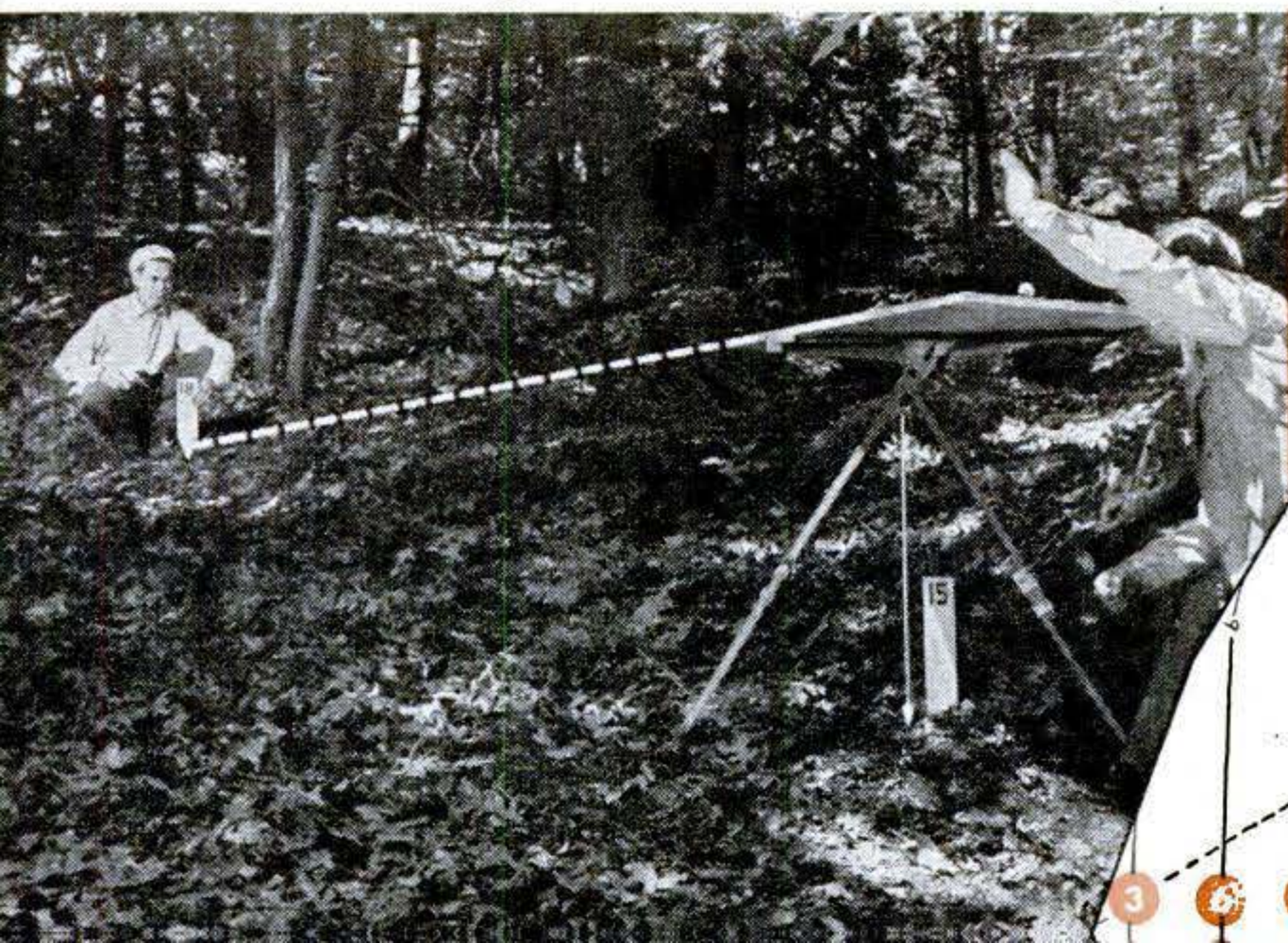
Determining Distances

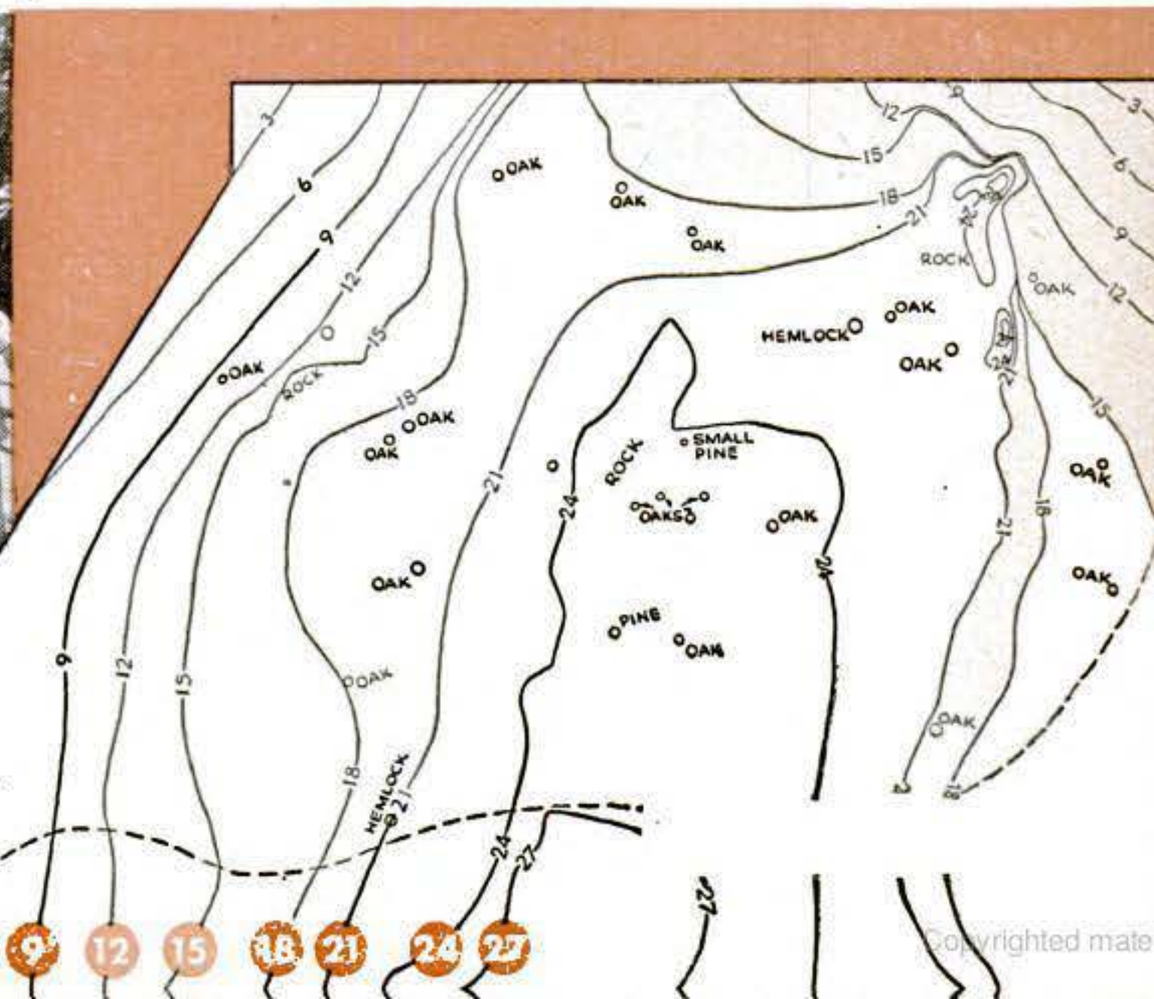
The vertical distance between each contour line is called an interval. The one you select should be governed by the roughness of the terrain. PS chose 3′ because the land was hilly and the area fairly large. To get sufficient detail on flatter ground, however, you may need to use a 2′ or even a 1′ interval. The smaller the interval, of course, the greater the detail.

The horizontal distance between contour points will also depend upon the way the land lies. Most of the time, the PS rodman was at the end of a 24′ cord, but where the contours turned too sharply to be plotted accurately at this length, the distance was cut to 12′, and at some points, even to 6′.

About the only piece of equipment you can't buy in a dime store is the table, and this you can beg, borrow—or make. The top can be any board that's reasonably flat and about 20″ by 30″ big.

To support the board, you'll need a tri-





1 First step, after boundaries have been drawn in on map, is location of points where contours cross a boundary, in this case the north one. Table is leveled up over lowest point, considered zero, and sight is made uphill along staked-out boundary. Then, since table is 3′ high, point on boundary where sight line meets ground is start of 3′ contour, and stake is driven in to mark it. To find start of 6′ contour, move table over 3′ point and repeat process. When you've reached highest point, here 27′, you're ready to begin working across land. Point on map representing corresponding point on land is placed over stake, not center of table. Map shown is more complete than yours will be at this time.

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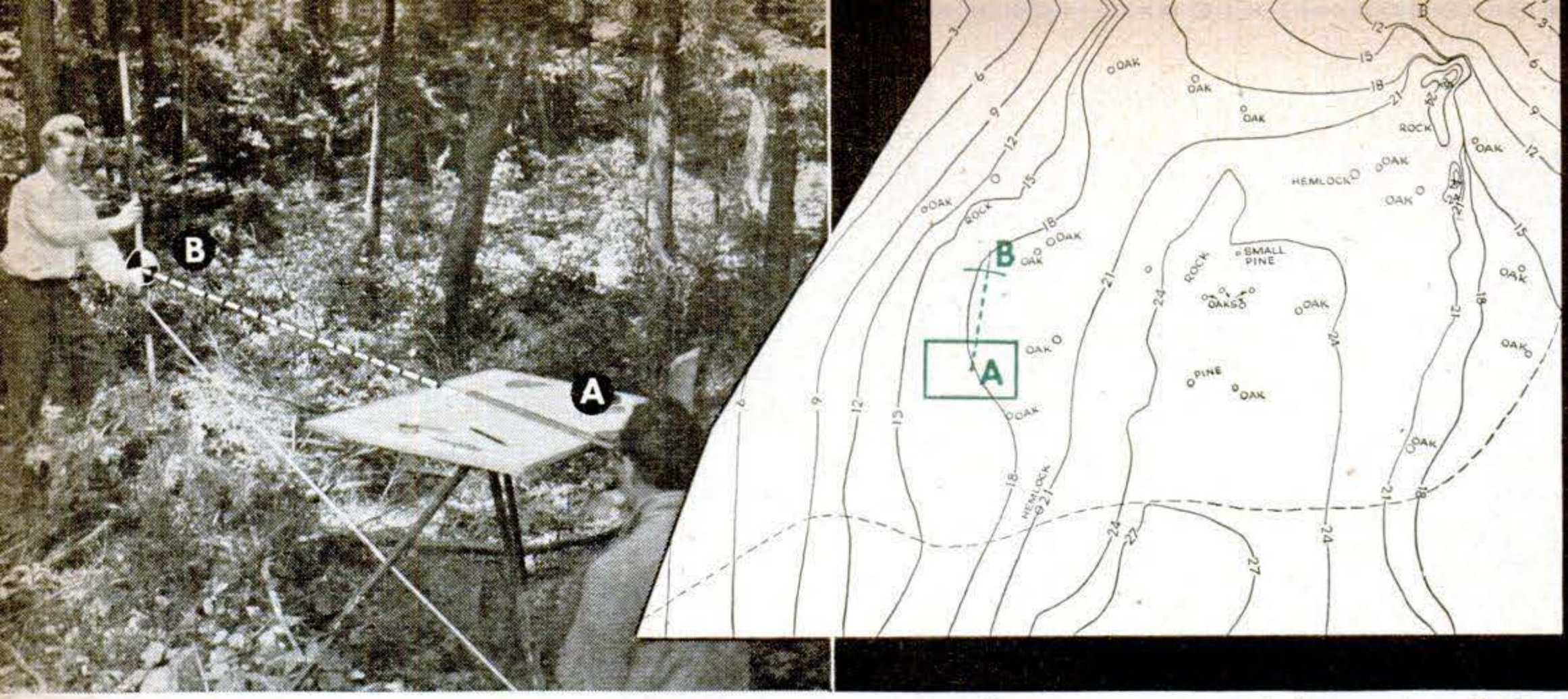
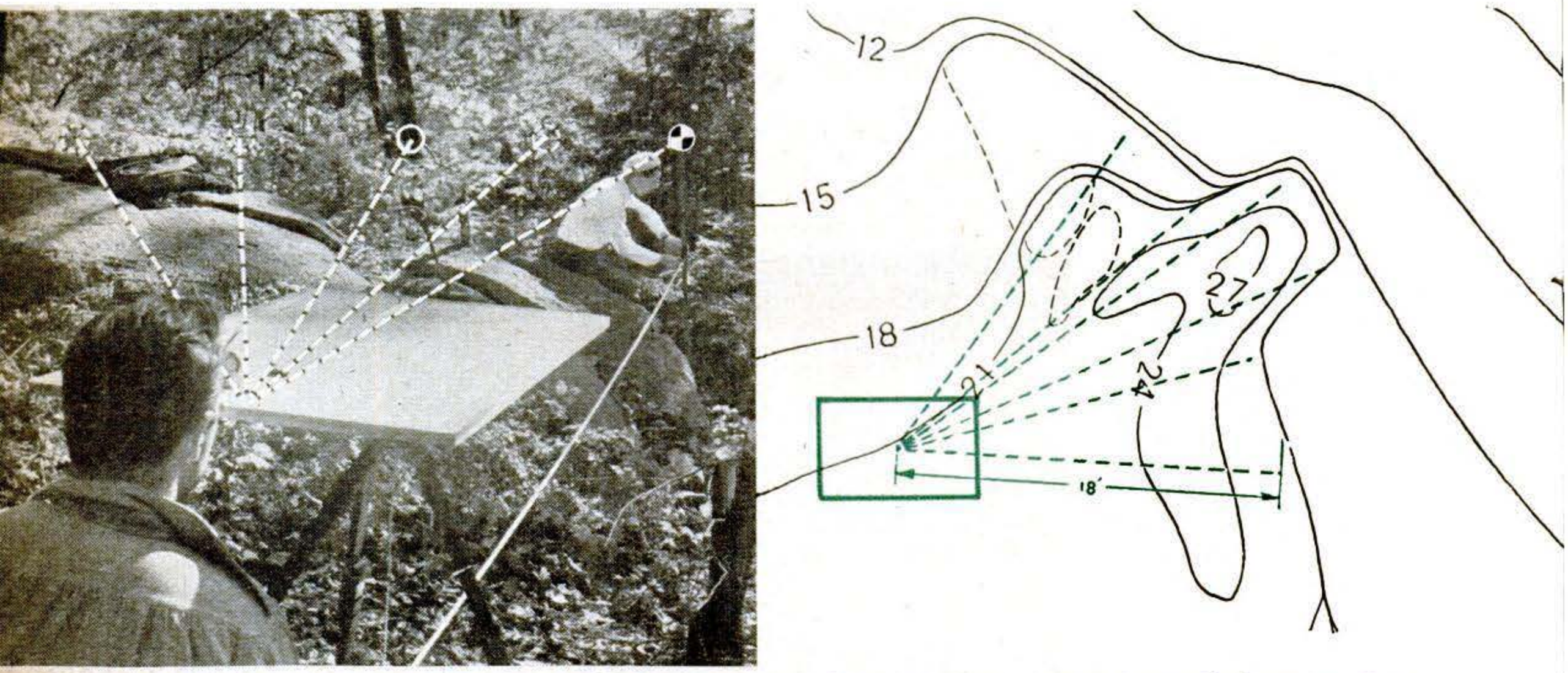


2 With table set up at A, a point of known elevation, rodman walks up and downhill with target at 3′ mark on pole. Line from pole to stake under table keeps rodman in 24′ radius. When target is level with table, sight line is drawn in along ruler to give rodman's direction, and compass arc, scaled to rodman's distance from map, is swung from A. Point where arc intersects sight line is thus same height as table's, and line AB becomes first leg of contour. In actual practice, you would start with table at a known point on boundary.



4 Called radial method, this trick lets you plot contours that turn too sharply to be followed easily, or features inaccessible with table, such as sheer 15′ bluff shown in map close-up at right above. Here table is set up at known contour point, and several sights are made to different points of equal elevation. Distance from table to each of these points is measured horizontally and then scaled onto corresponding sight line on map. Connecting the resulting points with a line then provides the contour's shape, in this case, the cliff profile.

pod that permits it to tilt and swivel. This can be a photographer's tripod, an artist's water-color easel, such as PS used, or just three sticks of wood hinged to a triangular block. Adjustable-length legs make it easier to level the table and adjust its height, but you can do this with fixed-length legs by simply spreading them apart. If you make your own tripod, fasten on the board with a single, flat-head bolt, so the board will swivel, and use a wing nut for easy tightening.

You'll have to adjust the table to the same height every time, so keep a weighted piece of string of the right length tied on underneath and be sure it just touches the ground when you set up. A good working height for the table is 3′. This has the added advantage, if you're using 3′ intervals, of allowing you to locate boundary-line contour points by sighting directly into the ground instead of on the pole.

You'll have to keep the table level, too—

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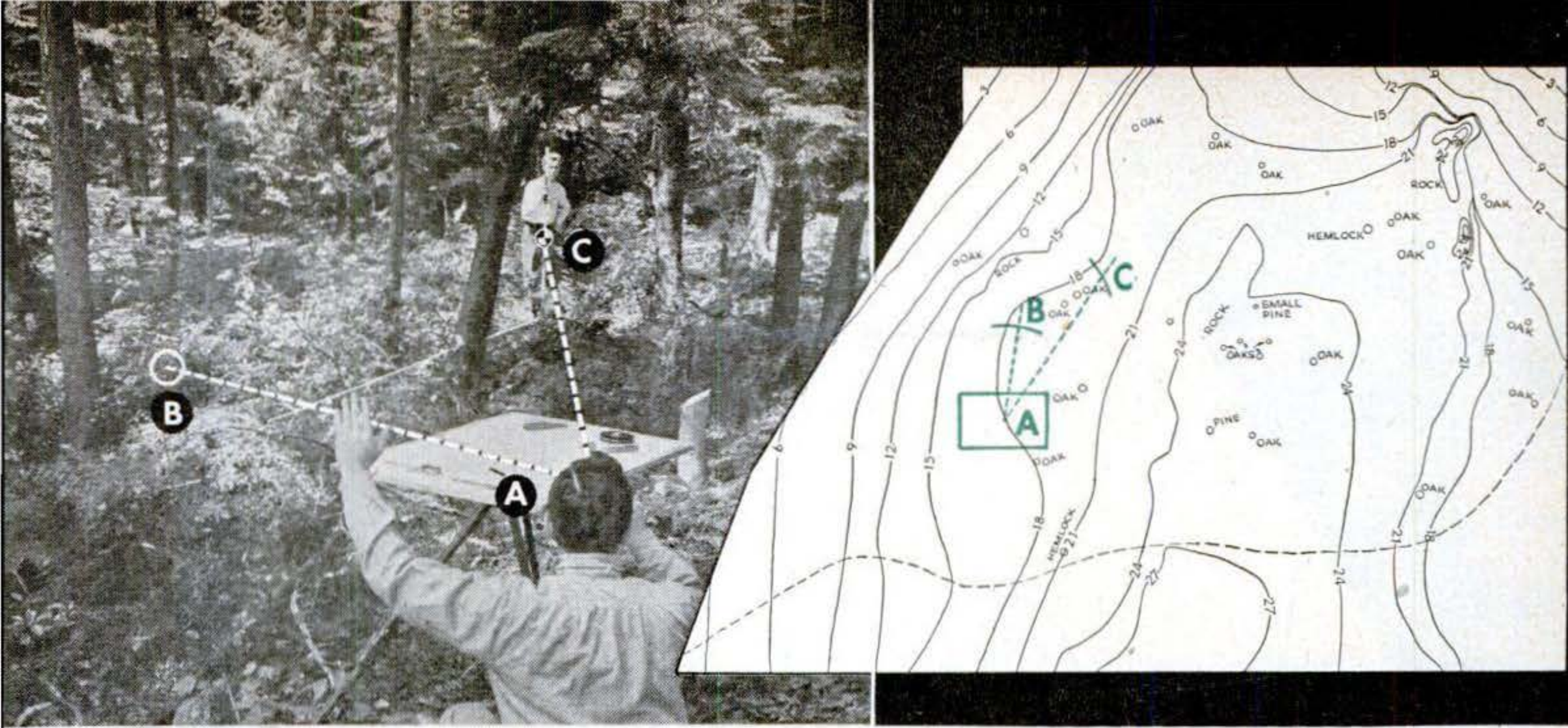
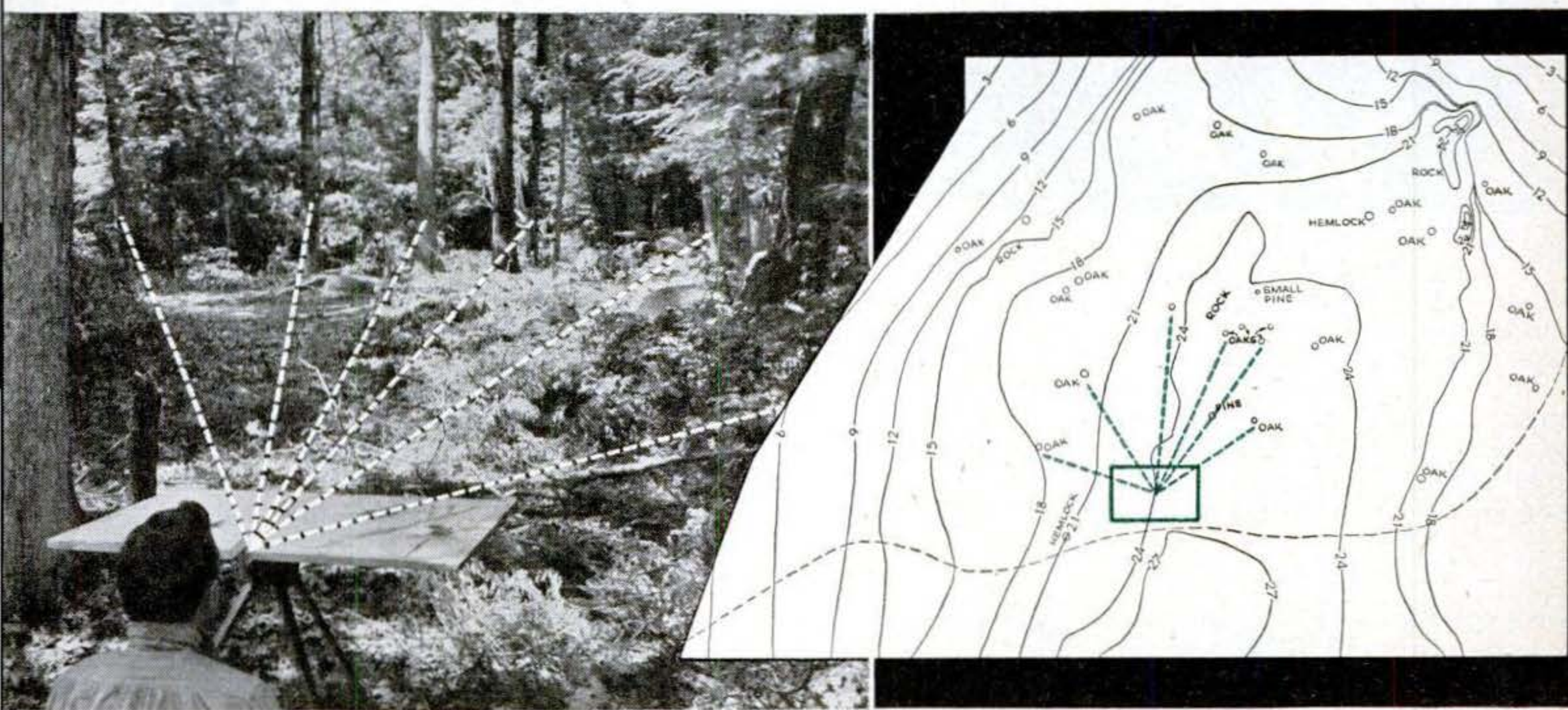


3 With table in same spot, second contour leg is made by repeating procedure, except here rodman's pole is tied to stake at B, instead of to one at table. When rodman's target is level with table, sight line AC is drawn on map, and compass arc is swung from B. Point where arc intersects sight line is rodman's position, and line BC becomes second leg. So long as rodman remains in view, any number of legs can be made in this way without moving table. Contour lines between points are drawn in by eye to approximate land's shape.



5 Locating trees, rocks, and other features not shown by contours will help you decide what must come out and what you'll want to keep when improving the land. Here procedure is same as radial method described previously except that no rodman is required, since only direction is needed, not elevation. With table at some already plotted contour point, sight direction of each surrounding tree and draw in sight line on map. Then measure distance from table to each tree and scale this on sight line to give you tree's location.

that's what makes the method work. This is done so that the sight line along your alidade to the rodman's marker pole will be level. Then when you sight on the pole at a point equaling the table's height, you know that the bottom of the pole is on a point of the same elevation as your table's location. A 50-cent spirit level is all you need, but remember to level the table along both axes to make sure it's level in all directions. And because the best table will wobble a bit, particularly when you're working on it, keep checking to see that it stays level.

To find the boundary lines of your map, locate the boundary stakes on your land. Use cord and stakes to establish the corner angles and measure these with a protractor, if your trigonometry is rusty. Measure the distances in between with a tape. With these angles and distances, you can then scale the boundaries onto your map.

The map scale you use will depend

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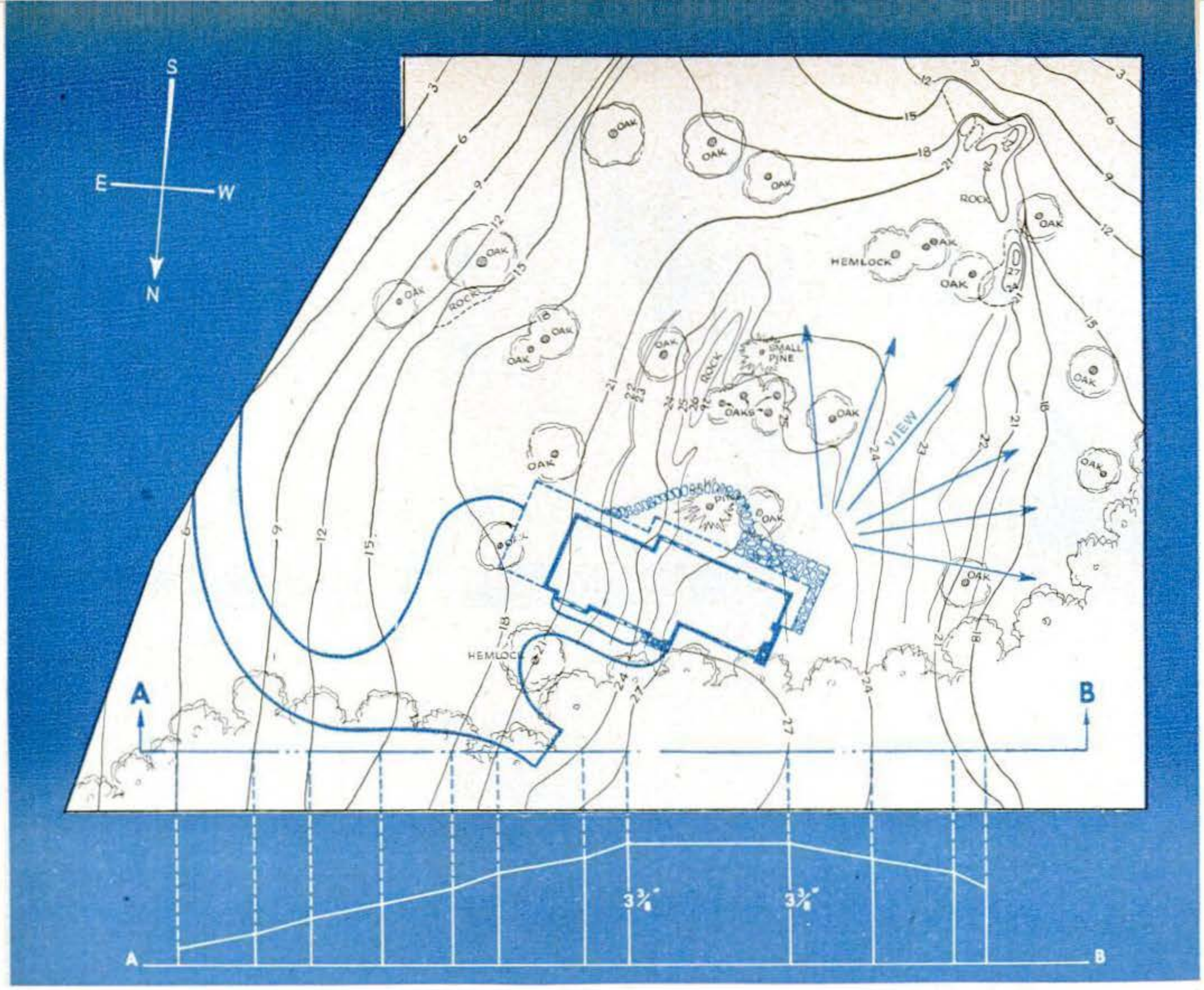

6 Finished map shows how contours help determine where house, driveway, and other features must go for maximum use of land, minimum excavation. Driveway crosses contours where they are widest apart, since grade is most gradual here. Note how placement of house makes use of natural dip in land at east end for car port underneath. Plotting in forest area shows how driveway turn-around can be shaped to dodge trees, preventing needless cutting. For greater detail, flat area around house was contoured in 1′ intervals. Quick way to get profile of any section through land is shown below map. Line is drawn through desired section on map, here at AB, and base line is drawn parallel to it off map. Vertical lines are dropped to base line from points where contours cross line on map. Scaling elevation of contours onto corresponding vertical lines and connecting resulting points gives profile.

upon the size of your property and of your board. If your longest boundary is under 100′, you may be able to scale it ¼″ to 1′. If longer, you'll probably have to use ⅛″ to 1′, as PS did. Needless to say, the larger the scale, the bigger the map, and the easier it will be to plot your contour points.

Compass Keeps Map on Beam

Before you begin plotting, line up one of the drawn-in boundaries on your map with its corresponding staked-out boundary on your land. Place a magnetic compass on the map and draw in a line in the direction the needle points. Now if you tape the compass to the board over this line, you'll always be able to keep the map oriented with the land by rotating the board until the compass needle lines up with the line on the map.

From here on, the accompanying pictures and diagrams show you how the method works—and from there on, you're on your own. In a coming issue, PS will show you how, with plywood and plaster, you can turn your contour map into a three-dimensional relief map, so you can really see how the land lies.

One final hint: Don't scorn the aid of willing helpers. While this is basically a two-man job, there are always trees to be chopped, underbrush to be cleared, and equipment to be carried. And don't let a sudden rain storm catch you mapping—take along some sort of cover, like a sheet of oilcloth or heavy paper, to keep the map from getting wet.

And if you're wondering just how much all this may save you in money, just subtract the $2.00 you've spent on equipment from the $200 or more a professional survey might have cost. That's your pay for a little weekend work in the woods. END

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Two-Way Lamp Displays

Marine Carving

By Harry A. Zoback
Author of "Internal Carving in Plastics"

YOU never have to feed the fish in this aquarium or worry about the cat snatching them for a quick snack. The aquarium lamp also serves a double purpose—a reading lamp and a night light. The fish, internally carved in plastic, are edge-lighted by a 7-watt bulb in the base that throws a soft glow throughout the room.

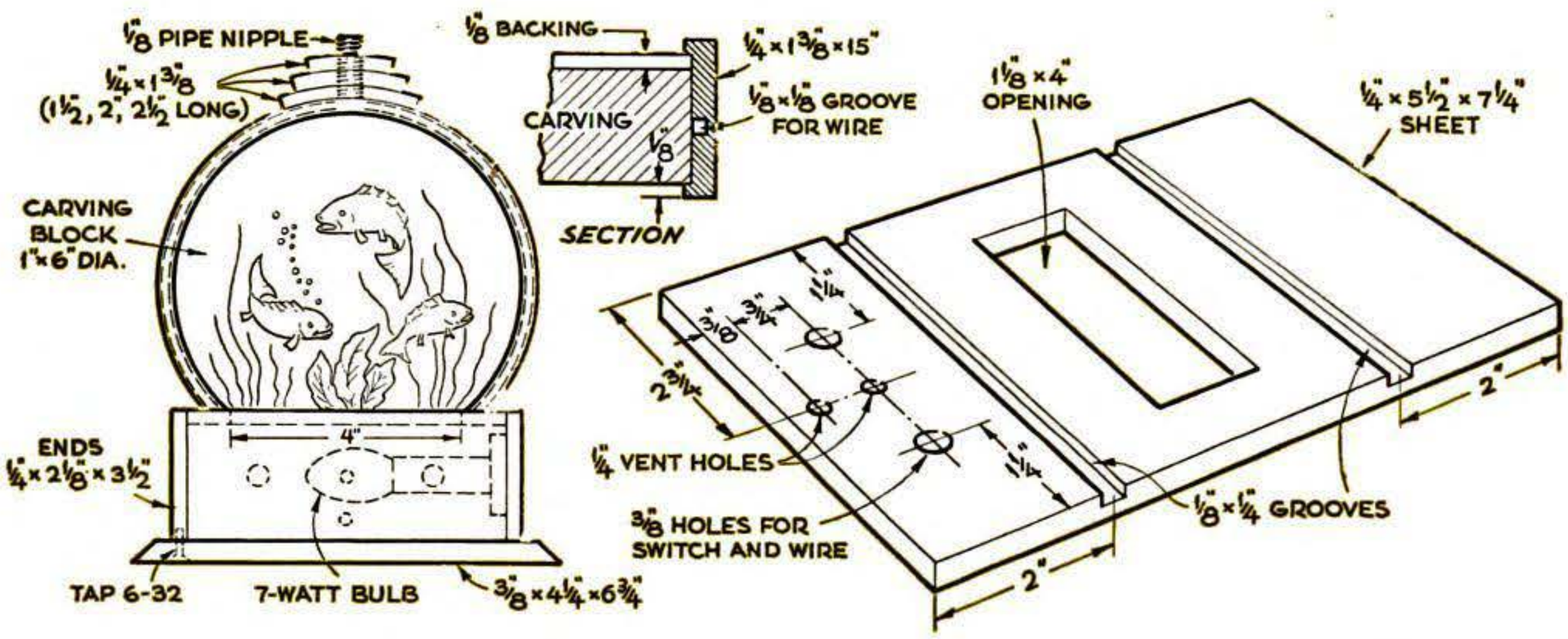
The base is ¼" black acrylic. Front, back, and top are made by grooving a single piece as shown in the drawing below. The grooves are laid over a strip heater until pliable. Then the back and front are bent 90° to the top. It's easier to cut out the rectangle and drill the holes before bending the plastic. Make the opening with a jigsaw or coping saw, and file and sand the edges smooth.

After bending the base, sand the bent edges flat and square to present a true cementing surface. Then cut the endpieces slightly oversize, cement on, and file or sand flush with the body after the joint is firm.

A 7-watt bulb in the base edge-lights the carving, which emits a soft, diffused night light.

Tap the edges of the base for the 6-32 screws that hold the bottom. Don't cement on the bottom; it must be removable to allow replacement of the bulb.

The ring that frames the carving is ¼" by 1⅜" by 15" black acrylic. On a circular saw, groove it 1/16" by 1⅛" to take the 1" thick carving block and a ⅛" backing. A light blue or green plastic backing is suitable. Next cut the ⅛" by ⅛" channel for the wire in the bottom of the groove. The sec-



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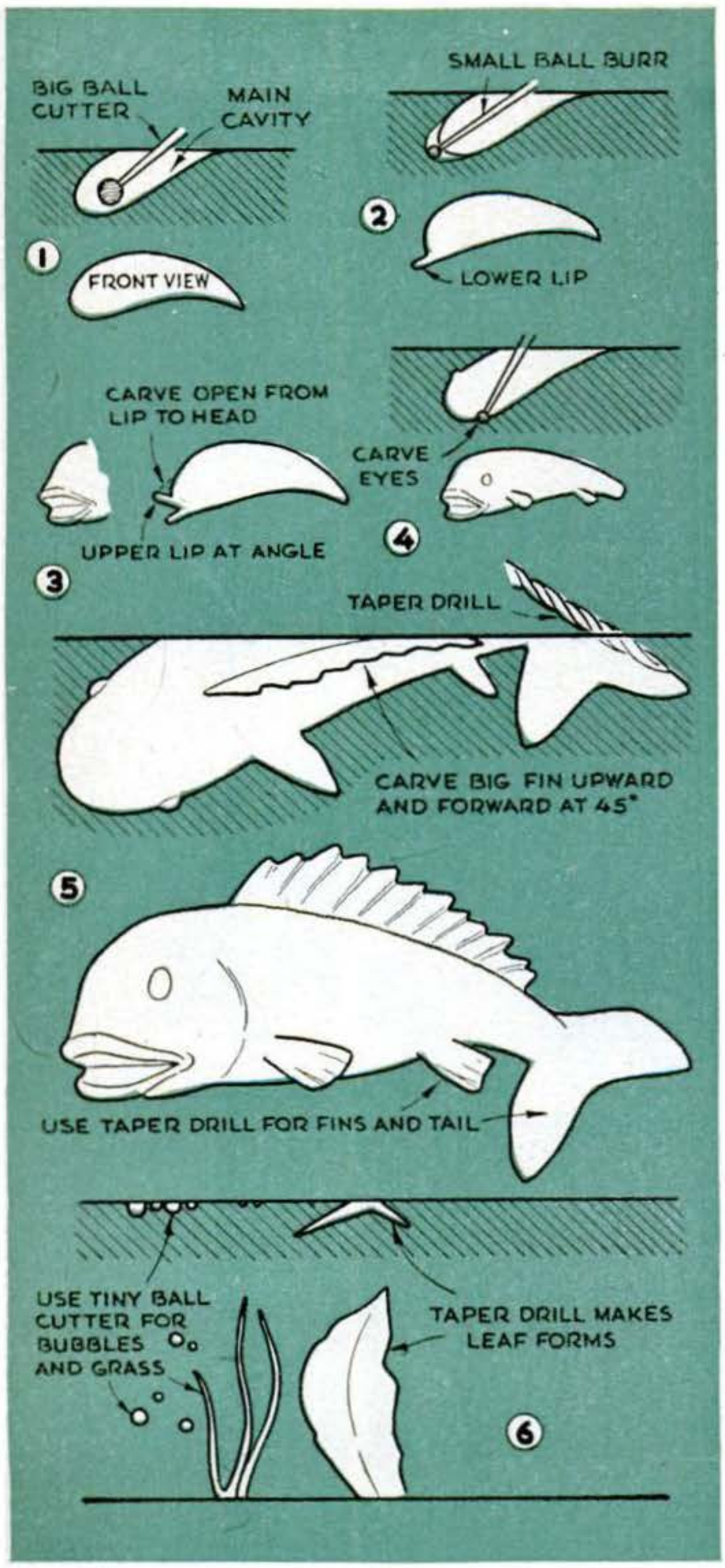
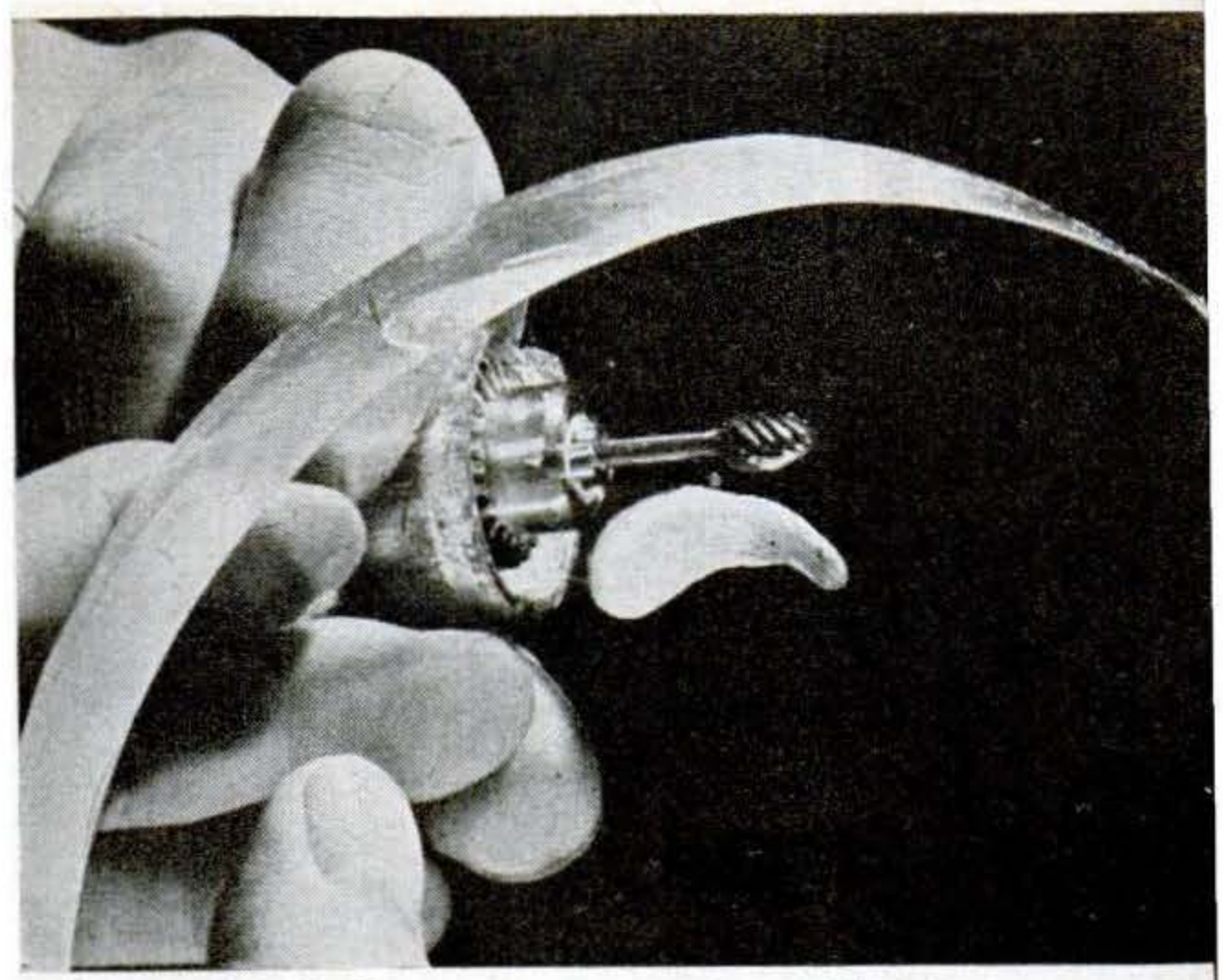
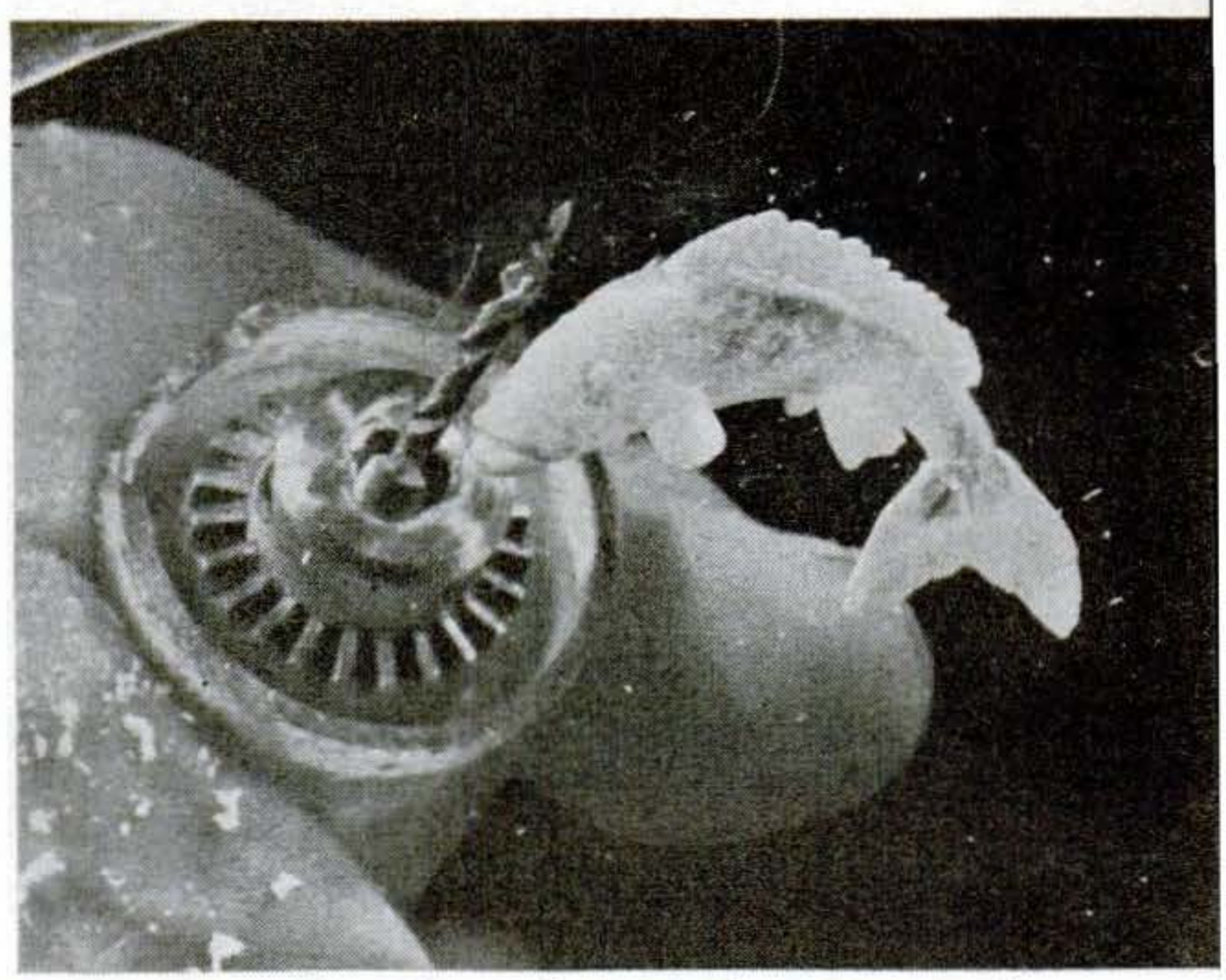


Steps in carving a fish are shown in front and sectional views. Lip contours flow into curve of head from one side to the other.



First step is hollowing main cavity with big ball cutter. Since lips and tail will add to its apparent length, don't overextend it.



Tail is carved with a downward sweep as shown in step 5 of the drawings at left. A tapered drill is used for this and all the fins.

tional view shows the grooves and the carving with the backing in place.

Cut and polish the three smaller blocks and cement them to the top of the frame. If you prefer the longer step effect in the photo rather than the more compact one in the drawing, make them 2″, 3″, and 4″ long. Place the frame assembly in an oven and heat to between 250° and 300°. When it is pliable, bend it around the circular carving piece, centering the three blocks at the top and trimming the ends to hook onto the 4″ wide flat on the carving stock. Before cementing it to the carving, drill it slightly undersize for a 1″ section of ⅛″ pipe nipple, and then turn the nipple in carefully to cut its own threads.

The shade is ⅛″ white translucent Plexiglas®. Use a 3/32″ drill to make the holes for the black plastic stitching. Cement the shade parts together and then stitch them. The four crossarms also are ⅛″ white translucent plastic, half-lapped where they meet and notched at the ends to fit under small blocks cemented to the shade panels. A ⅜″ by ½″ by ½″ block of clear plastic is drilled to take the lampshade harp and cemented in the center of the crossarms. The finial is a

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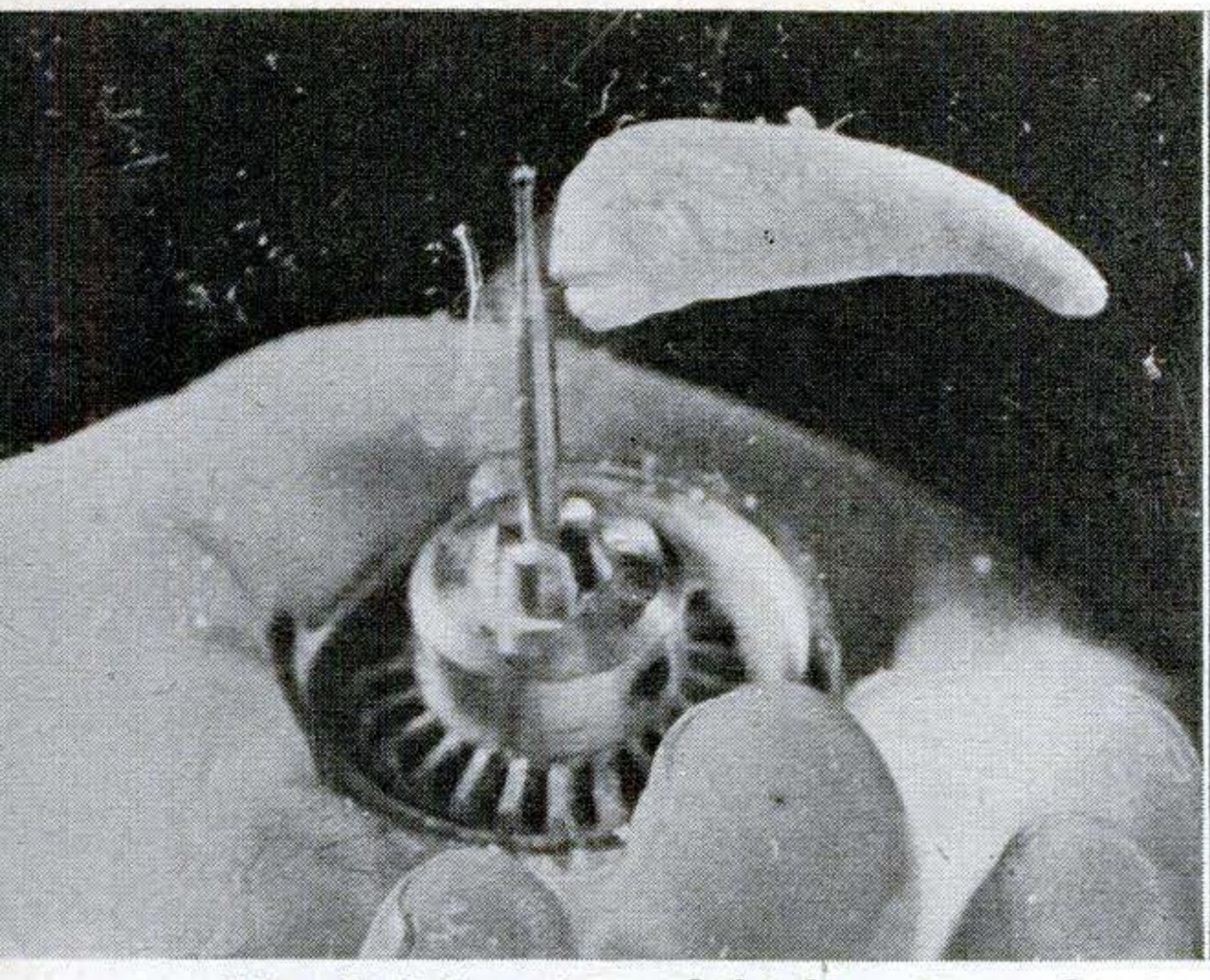
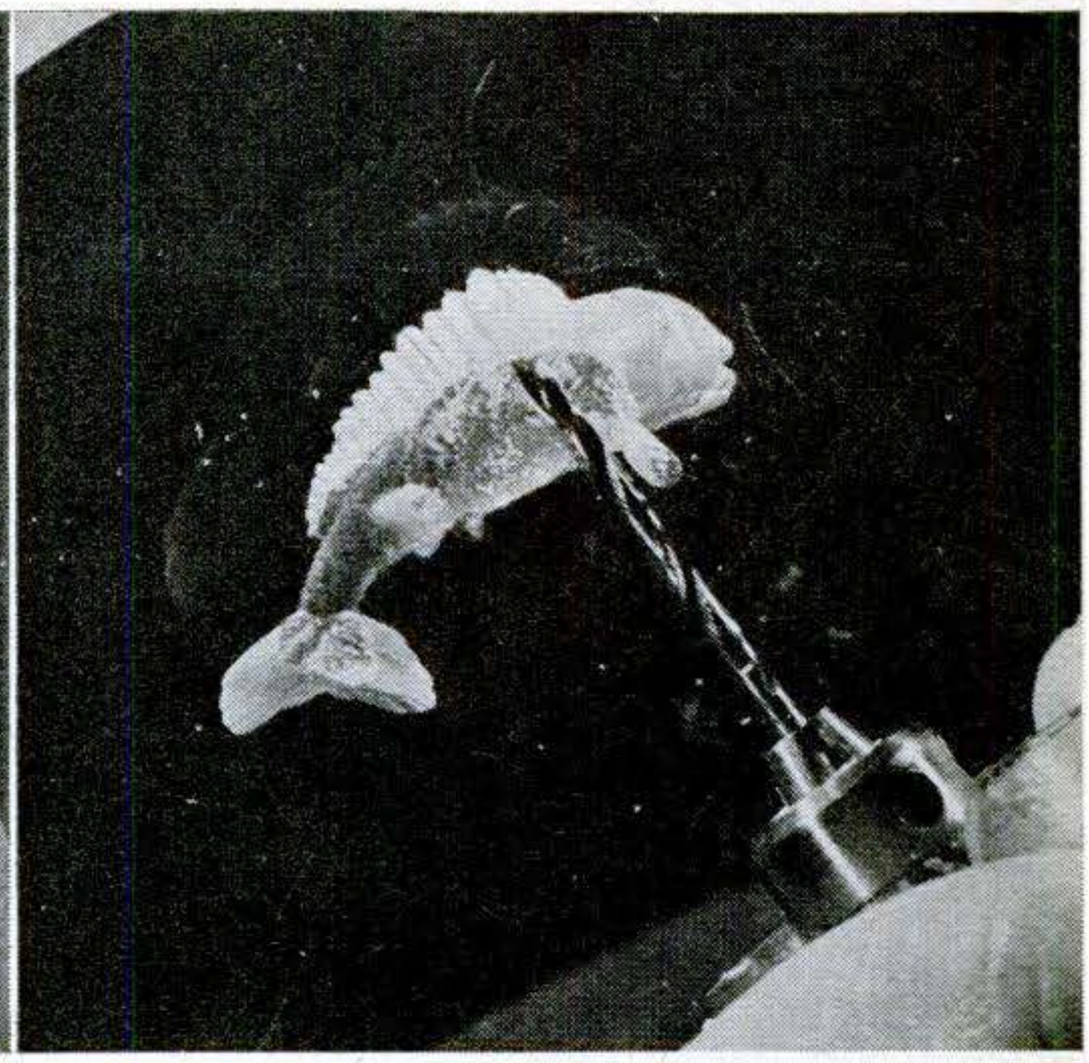
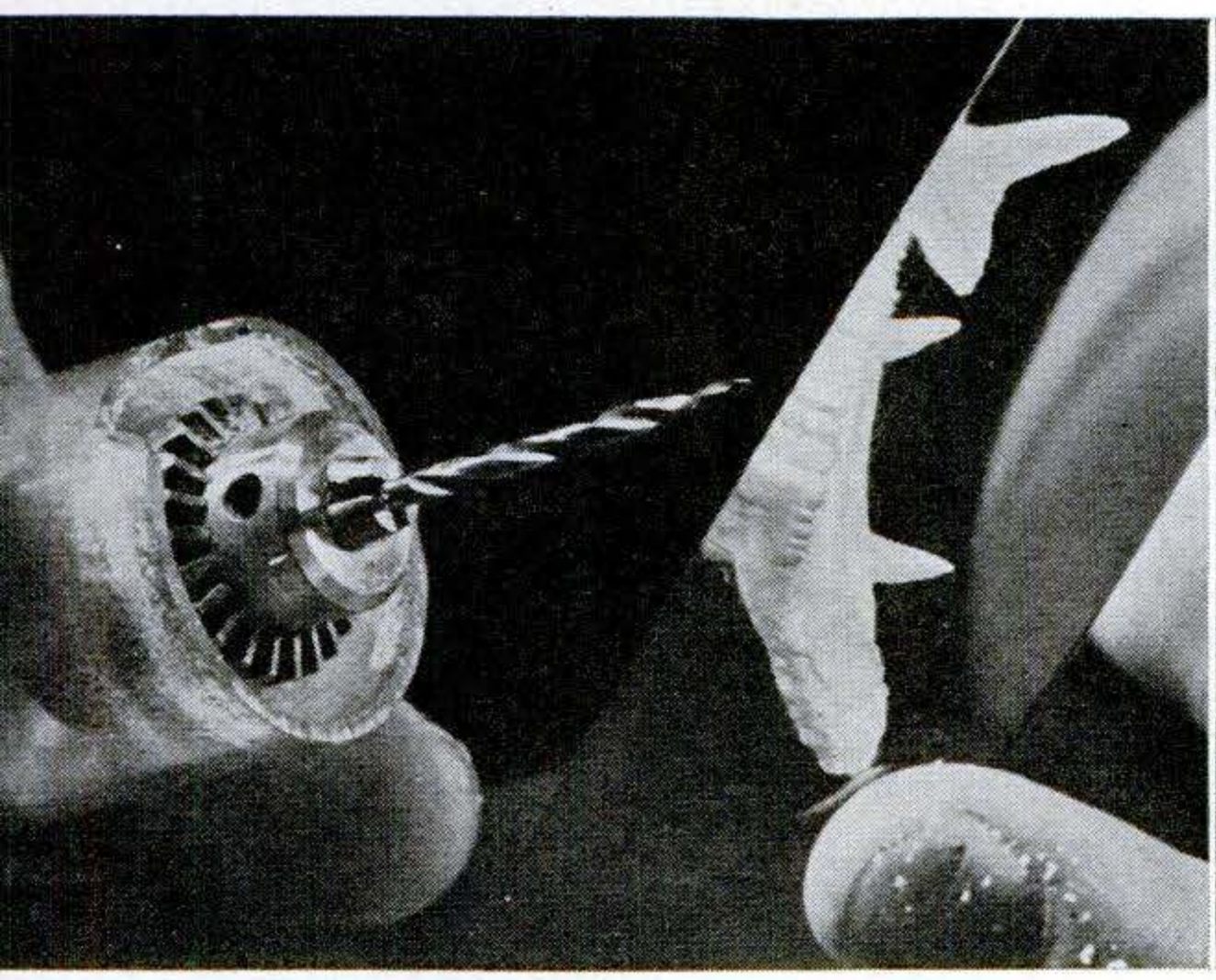


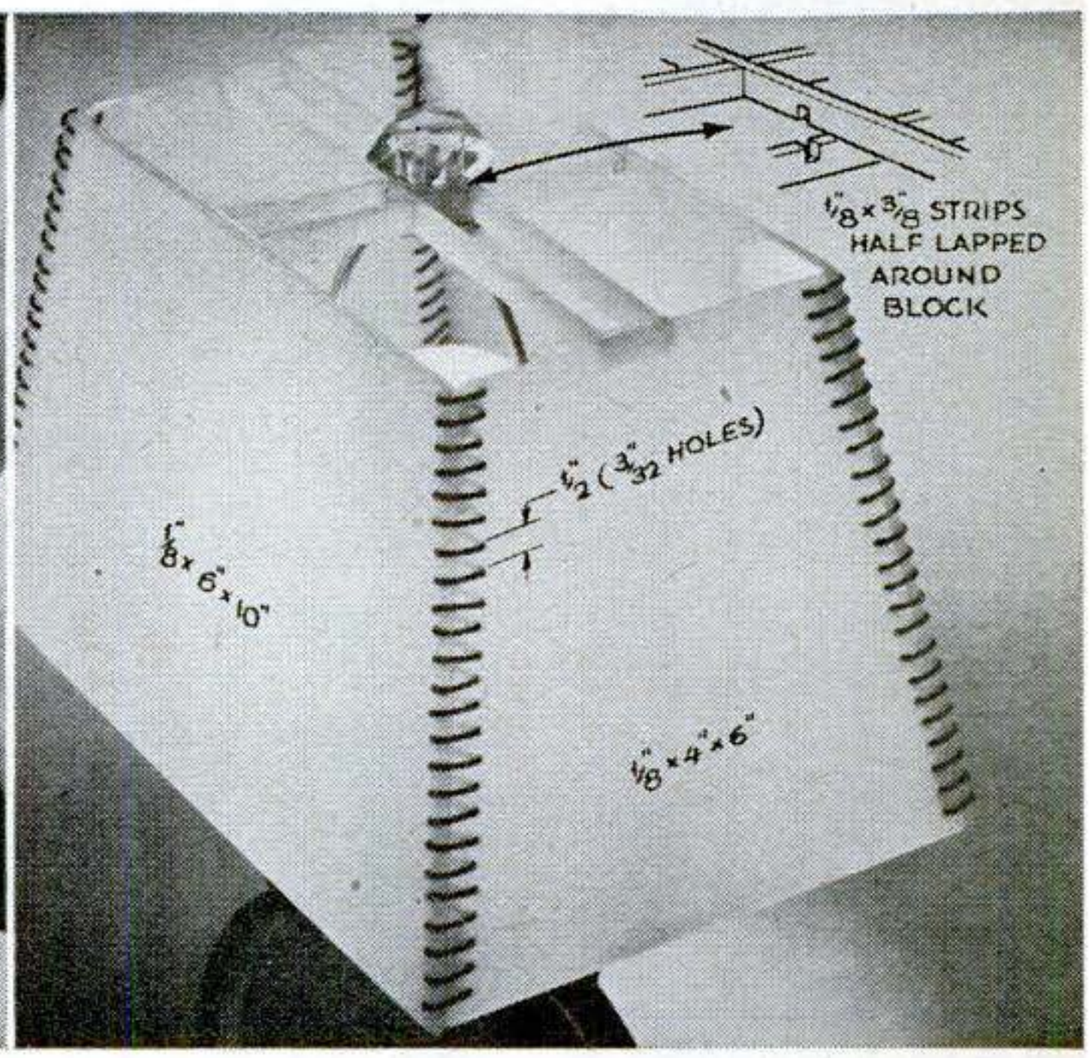
Tiny ball burr is used for lips. Lower lip is extension of bottom body line; upper lip is slanted and head is hollowed out toward it.



To form top fin, drill is swept sidewise at 45° angle along top of body. Crests or points are formed by simultaneous in-and-out motion.



Edge-on view of the work shows sweep of main body cavity and tail as seen from above. Front half of body is wholly inside the plastic.



Top edges of shade panels are 2″ shorter than bottom. Finial is plastic block, beveled into gemlike form and buffed to a high polish.

clear block of ⅝″ by 1″ by 1″ that is tapped ¼″-20, beveled, and polished.

Although the fish vary slightly, the same carving techniques apply to all. Before carving them, lay out the designs with India ink or china-marking crayon. With a pear-shaped burr or ball burr, carve out the bodies (PS, Aug. '47, p. 160). A small ball burr will make the mouths. Use a taper drill for the tails and fins. Scales may be simulated with the ball drill or an end mill.

Note that the body curves in two planes, the head being wholly within the block while the tail cavity breaks out of the back surface. This is shown in the front and sectional carving drawings on p. 186. The lower lip is level with the bottom line of the body, and the upper one is carved at an angle to it. Round out the curve from top of the head to upper lip. The top fin is not carved straight up but is slanted at an angle of about 45°.

When the carving is completed, place it and the backing in the frame with the lamp cord in place. Cement the assembly into the base. Screw on the bottom and then attach the shade. All parts should be cleaned and waxed before assembly. END

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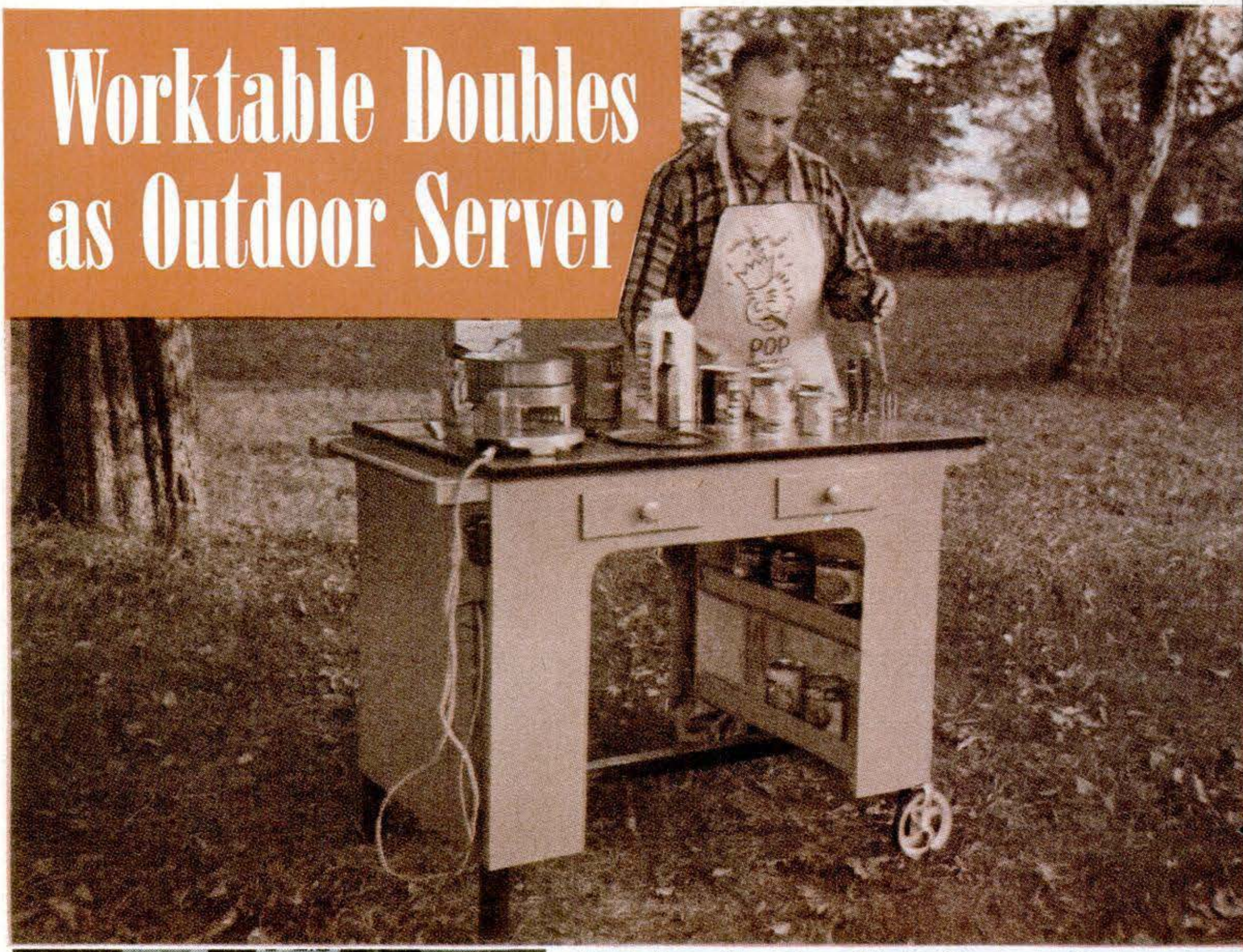
Worktable Doubles as Outdoor Server



Out where the ants and butterflies roam, Pop whips up a fast meal. Indoors, at left, he uses the same unit as a portable workbench.

By Arthur C. Miller

INDOORS or out, you'll find this rolling utility table an all-round work horse. During the winter, you can use it as a workshop table, kitchen table, or snack server. In warm months, it can be trundled outdoors. Its electrical connection may be used either to prepare meals or power a hand grinder, drill, or soldering iron.

The table can be built with hand tools, but you'll save time by having a lumber yard cut out the ¼″ plywood sides and ends if you don't have a circular saw. Drawers—usually tricky construction jobs—are no problem here. The two used in the table are dime-store cutlery holders with plywood facing and knobs added.

Butt joints, held by 2″ angle irons and reinforced with waterproof glue, are used throughout the frame. You'll need 16 angle irons and two 16′ lengths of two-by-two.

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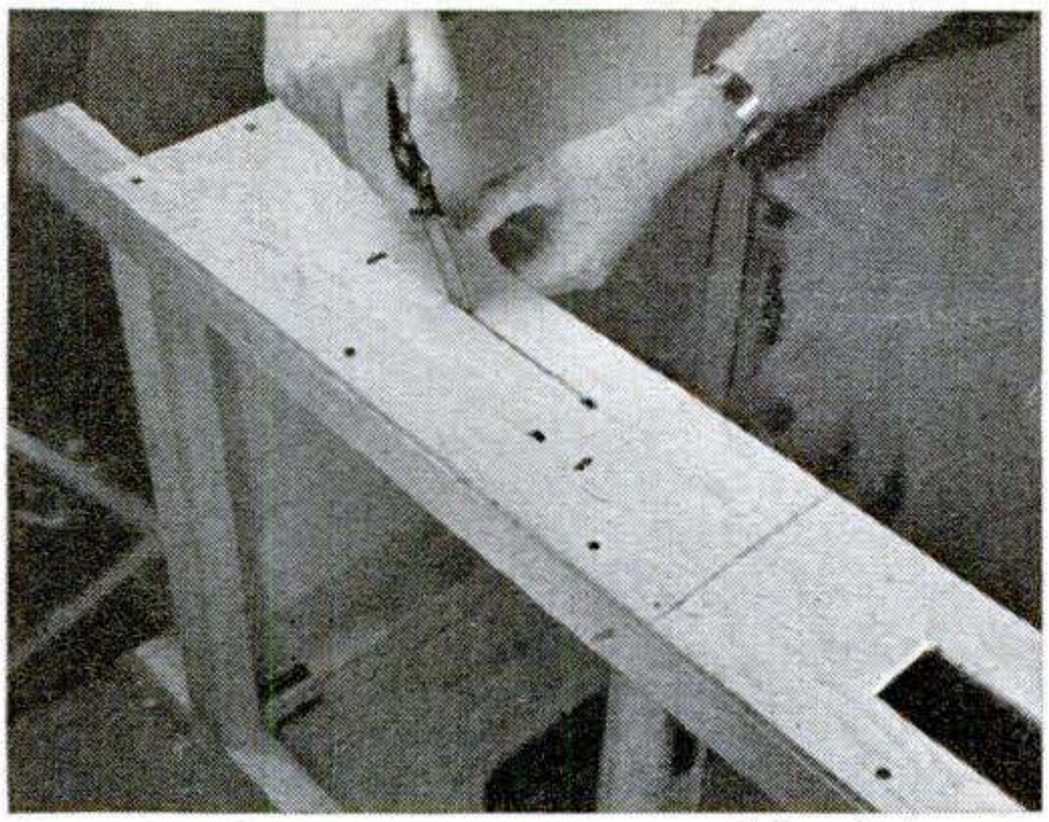
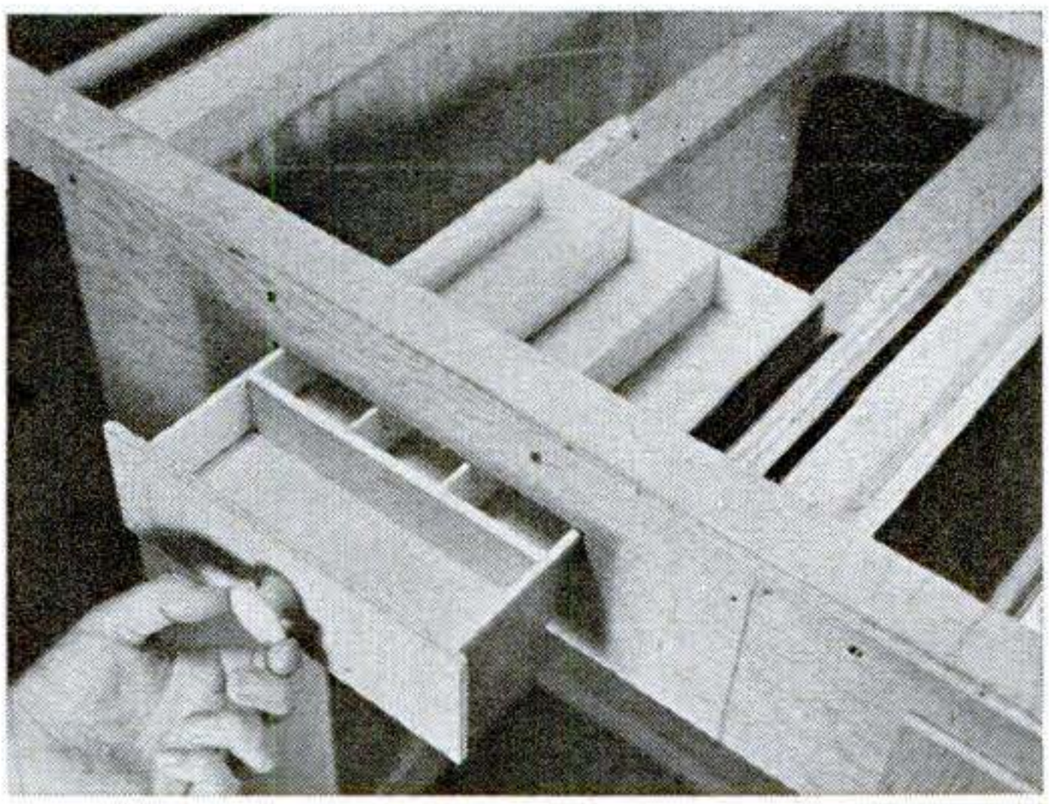
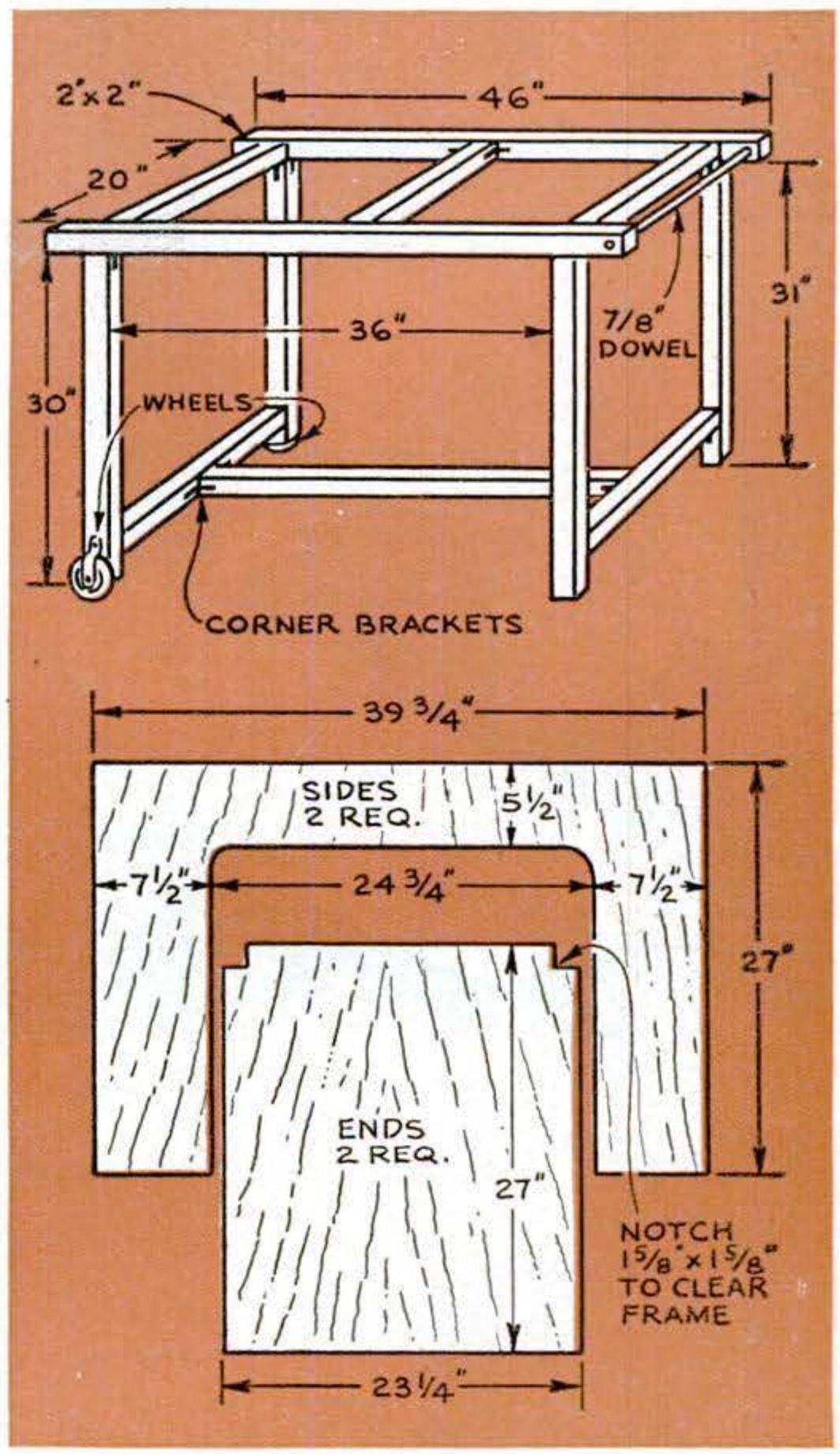


Slots for drawers are cut out with keyhole saw after starting holes are drilled. Drawers are partitioned cutlery boxes from dime store.



Drawer slides are 1″ by 2″ by 23¼″ strips bradded to sides. Drawer guides are ½″ square. Quarter-round molding can be used for guides.

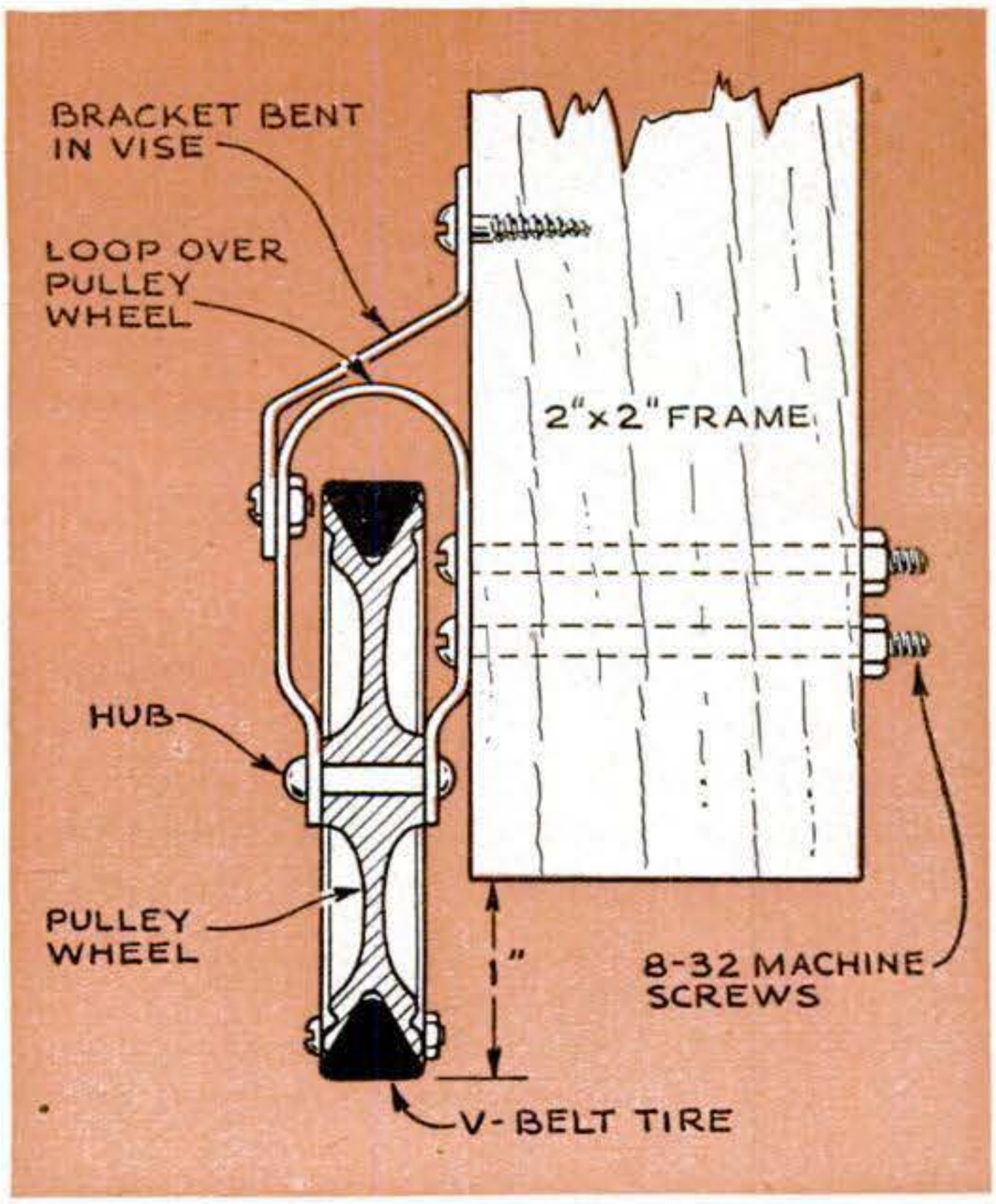


Frame and plywood panels are shown above. Method of attaching clothesline-pulley wheels to two legs of table is detailed in drawing below.

One-inch brads hold the plywood to the frame. The four shelves add rigidity to the table and also serve as storage spaces. They're sawed from 1″ stock and measure 6½″ by 23¼″. Anchor them to the sides and ends with brads through the plywood. Tack a 2¼″ plywood fence to the front of each shelf to keep things from falling out when the table is moved.

The wheels are 5½″ clothesline pulleys with V belting for tires. To hold the belting in the rim, drill two holes through the side of the rim and through the two ends of the belting. Pass 6-32 machine screws through and lock them with nuts.

Boards for the top are 1″ pine 42½″ long. The handle bar can be a 1″ dowel or a piece of broomstick. Beneath one end of the bar is a twin outlet box wired to 25′ of heavy-duty cord. Two clothes hooks, mounted as shown in the photos on the opposite page, are used to store the cord. END



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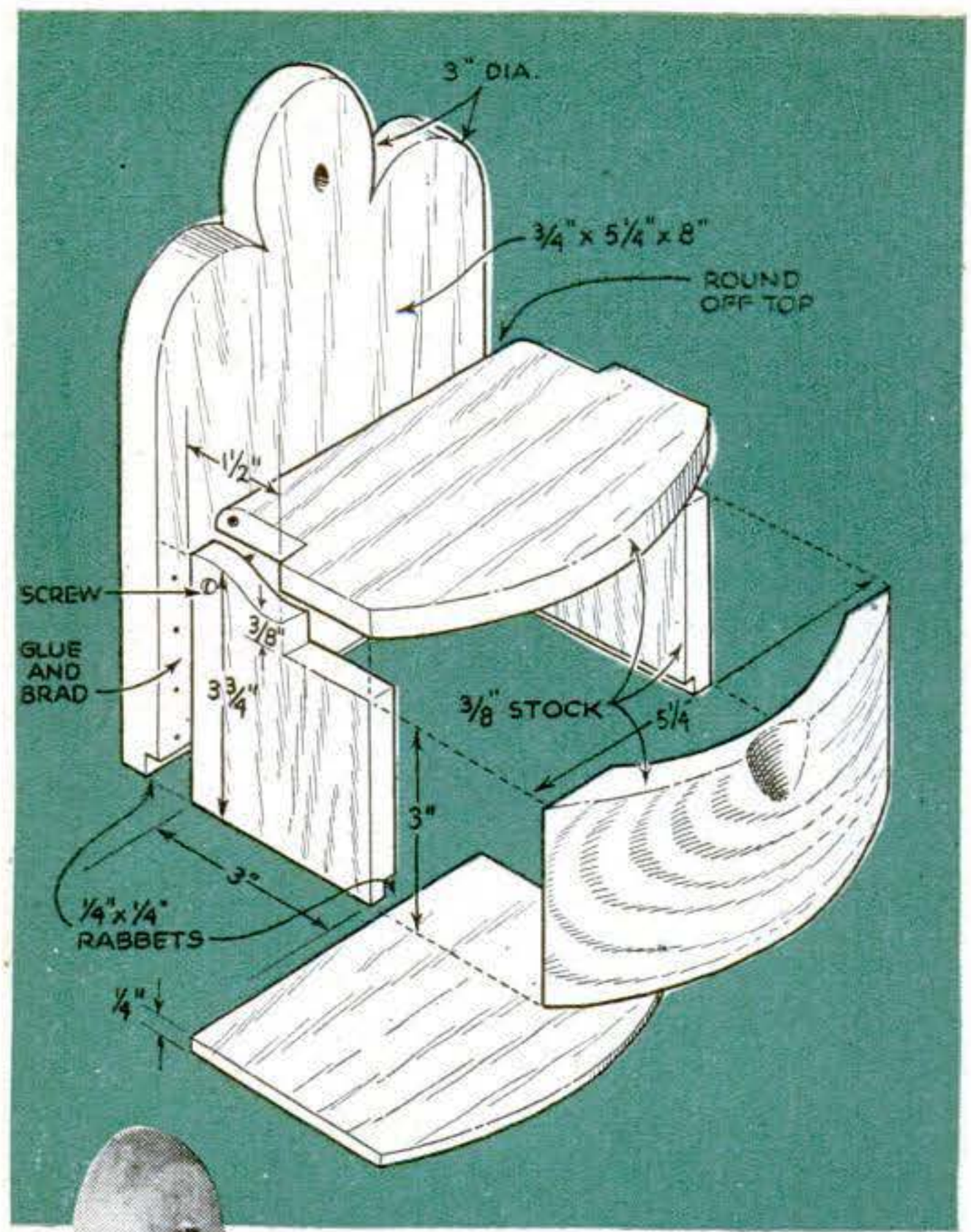


Salt Box Built of Scrap Wood

PARTS of an old orange crate provided all the stock needed to build this copy of an Early American salt box. Outside the kitchen, it'll hold gloves, keys, or cigarettes. You can build it with hand tools by altering the design to a straight front and a butt joint at the bottom instead of the rabbet.

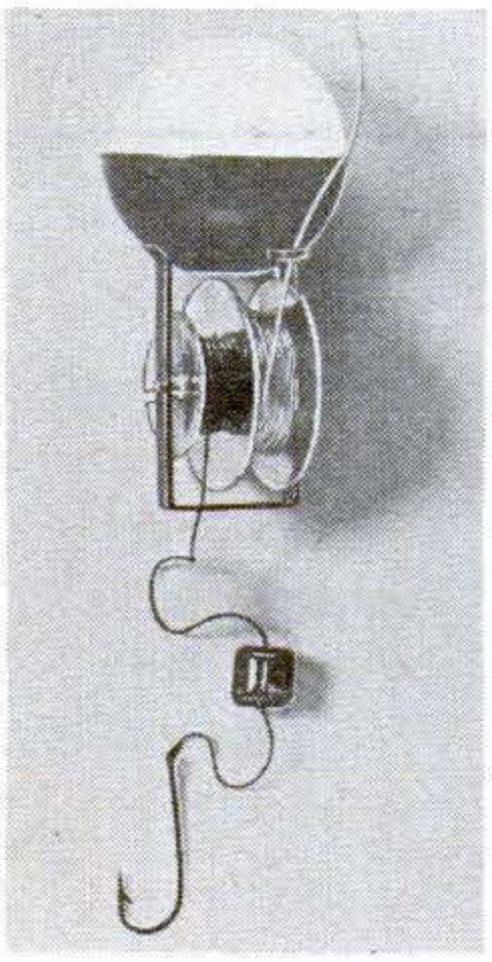
Bandsaw the curved front and smooth the faces on a drum sander. The shallow finger recess for lifting the lid also may be sanded to shape. One of the pleasing features of this project is the simple screw hinge. Use roundheaded brass or blued screws about 1″ long. Drill the holes through the sides and into the lid while the lid is clamped in place. Note that the top of the lid's rear edge is rounded to prevent binding against the back when opened.

All joints are glued and bradded. The brads are countersunk and the holes filled with composition wood before final sanding. Two coats of orange shellac topped off by two coats of paste wax complete the job. Apply the wax with No. 00 steel wool and polish the box thoroughly.—*Norbert Engels, South Bend, Ind.*

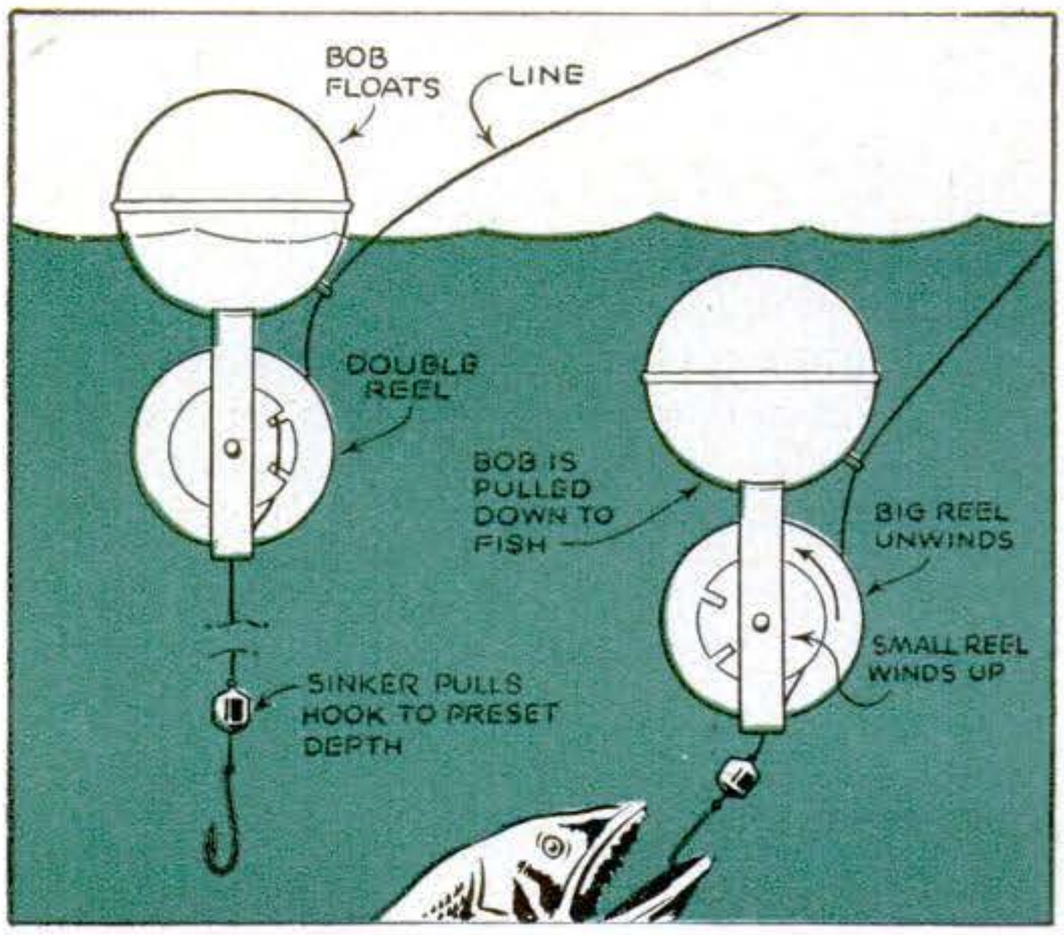
Rod Aids Bike Beginner

LOTS of spills can be avoided if a beginner bike rider is steadied by an adult with a broomstick as shown in the photo. The stick is passed through the upper fork behind the seat and into the lower fork beside the sprocket. If the stick is too large to fit the lower fork, whittle it down until it's a snug fit. A few lessons like this and the young rider will be on his own.—*John Eckhoff, Jamaica, N. Y.*

Bobber Goes Down to Fish



WITH the Deep-O-Bob® you can cast and still-fish at the same time. The brass and aluminum bob has a double reel—one large and one small. Cast out with a rod or hand line, it automatically releases the hook to any preset depth down to 18′. Due to the different ratio of the two spools, the bobber automatically goes down to the fish as soon as he takes the hook. This results in a tight line at all times. The harder the pull, the faster the bob will wind itself down to the fish. Deep-O-Bob is finished in white and red. Retail price is about $2 from J. F. Cottler Co., Oak Park, Ill.



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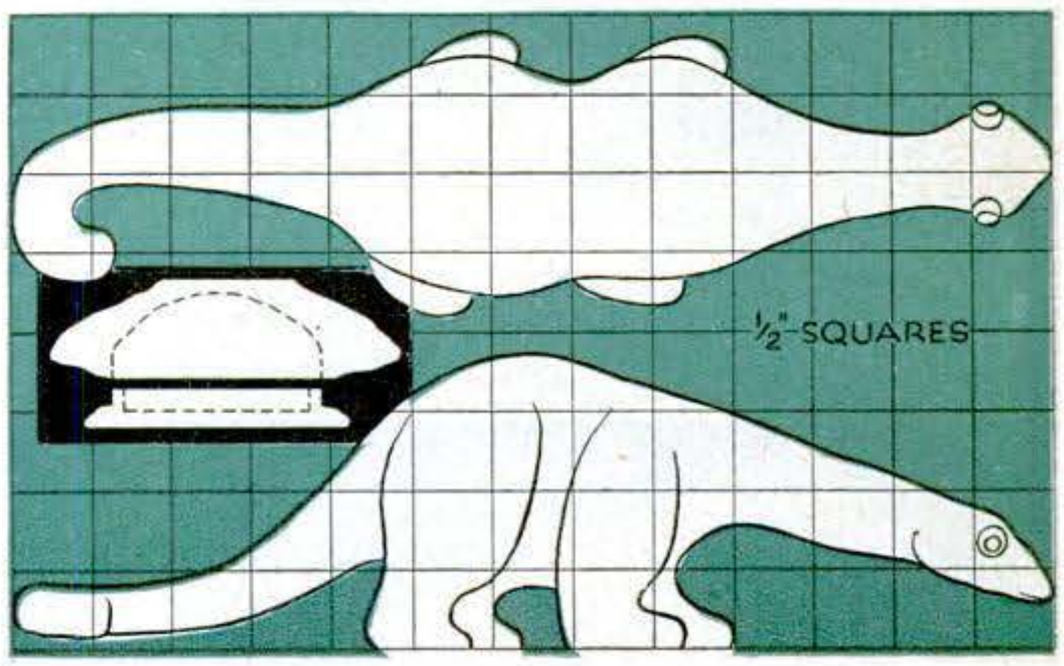
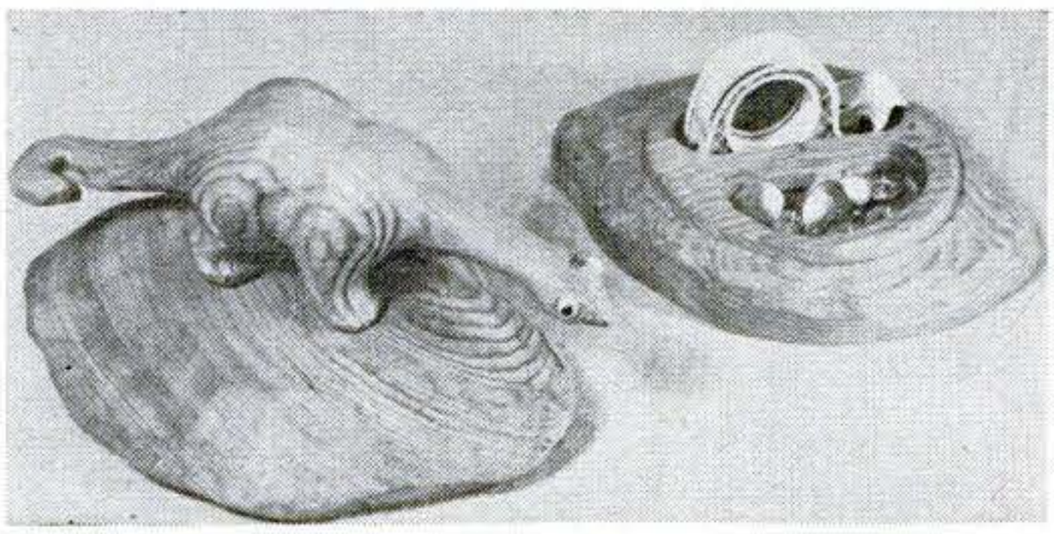
Brontosaurus Guards Desk Box

ONE of the largest of the dinosaurs, the brontosaurus, is carved in miniature to decorate this utility desk box. The recessed base holds cellulose tape and thumbtacks.

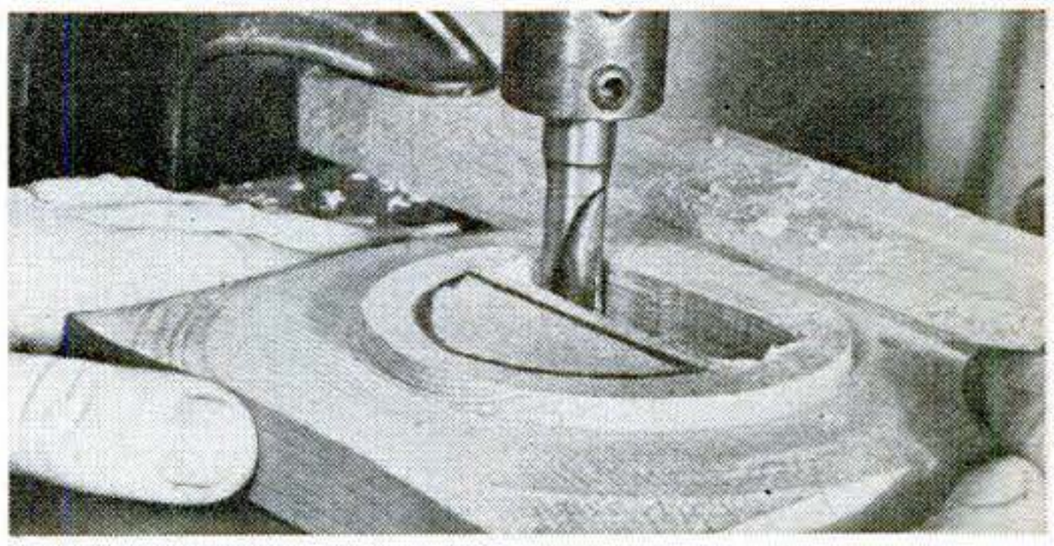
I used 2″ redwood with the grain running the length of the figure. This wood carves easily and needs only a coat of shellac to finish it. Lay out the figure and cut away much of the wood along the back and under the neck with a coping saw. Carve the figure to give it a pudgy, well-rounded look. Remove wood from between the legs with a drill and finish by carving. Sand the figure smooth. The eyes are white map pins set in drilled recesses. Pupils, lips, and nostrils are painted on with India ink.

Two blocks of redwood make the base. Mount the top part in a lathe and turn out the inside. Then turn the lip in the lower section and rout out the partitioned recess. The lip is only about ⅛″ high, just enough to hold the top in place on the lower part. Next step is to saw the two sections to the rough oval shape shown in the photos, and finish them by carving. Small screws through the top and into the feet hold the figure to the flat top of the base. You can finish the box and figure with a coat of shellac or lacquer.—*Elma Waltner, Hurley, S. D.*





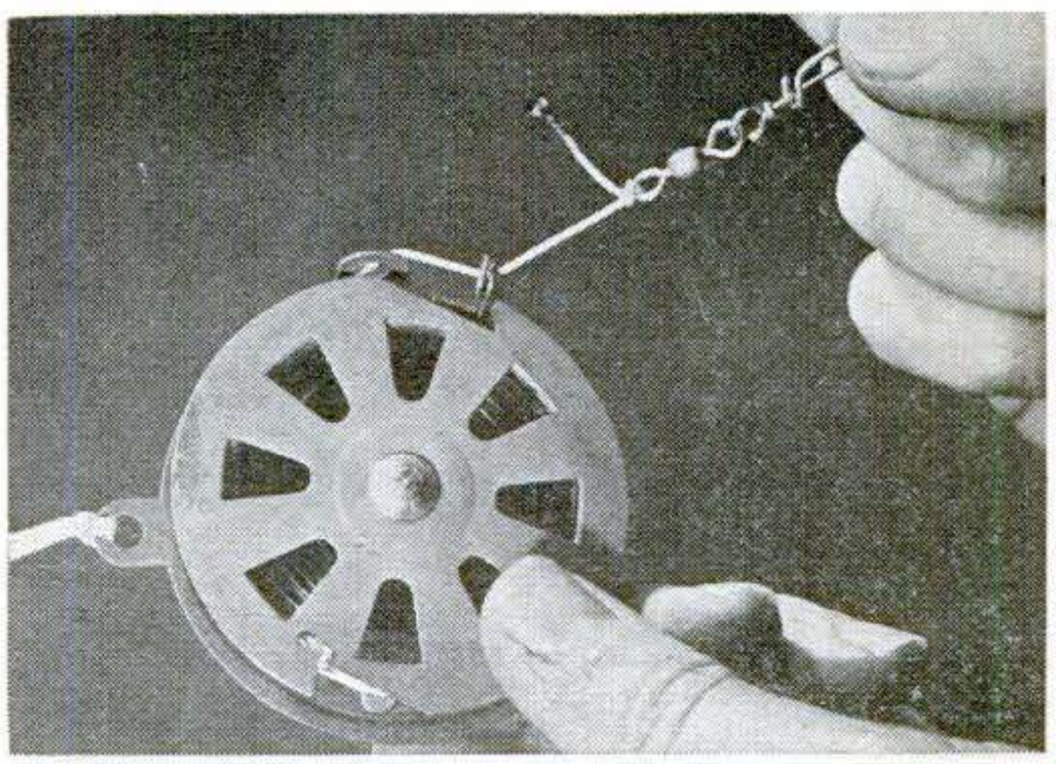
Finished box has appearance of flattened rock with small figure of dinosaur mounted on top.



Partitioned recess in lower part of base is cut out with a router bit mounted in a drill press.

Spring-Powered Reel Does Your Fishing for You

A COIL spring around the axle of the Auto-Fisher® is the muscle that sets the hook and plays the fish, according to the maker, White Bros. & Co., of Little Rock, Ark. One end of the spring is attached to the axle. The line is secured to the other end of the spring. To use the automatic fisherman, you pull as much line from the reel as you want and set the trigger in one of two notches. A cord through the eye holds the reel to a tree limb, dock, or boat. When a fish takes the bait, he trips the trigger and the spring takes over. The device is priced at about $1.



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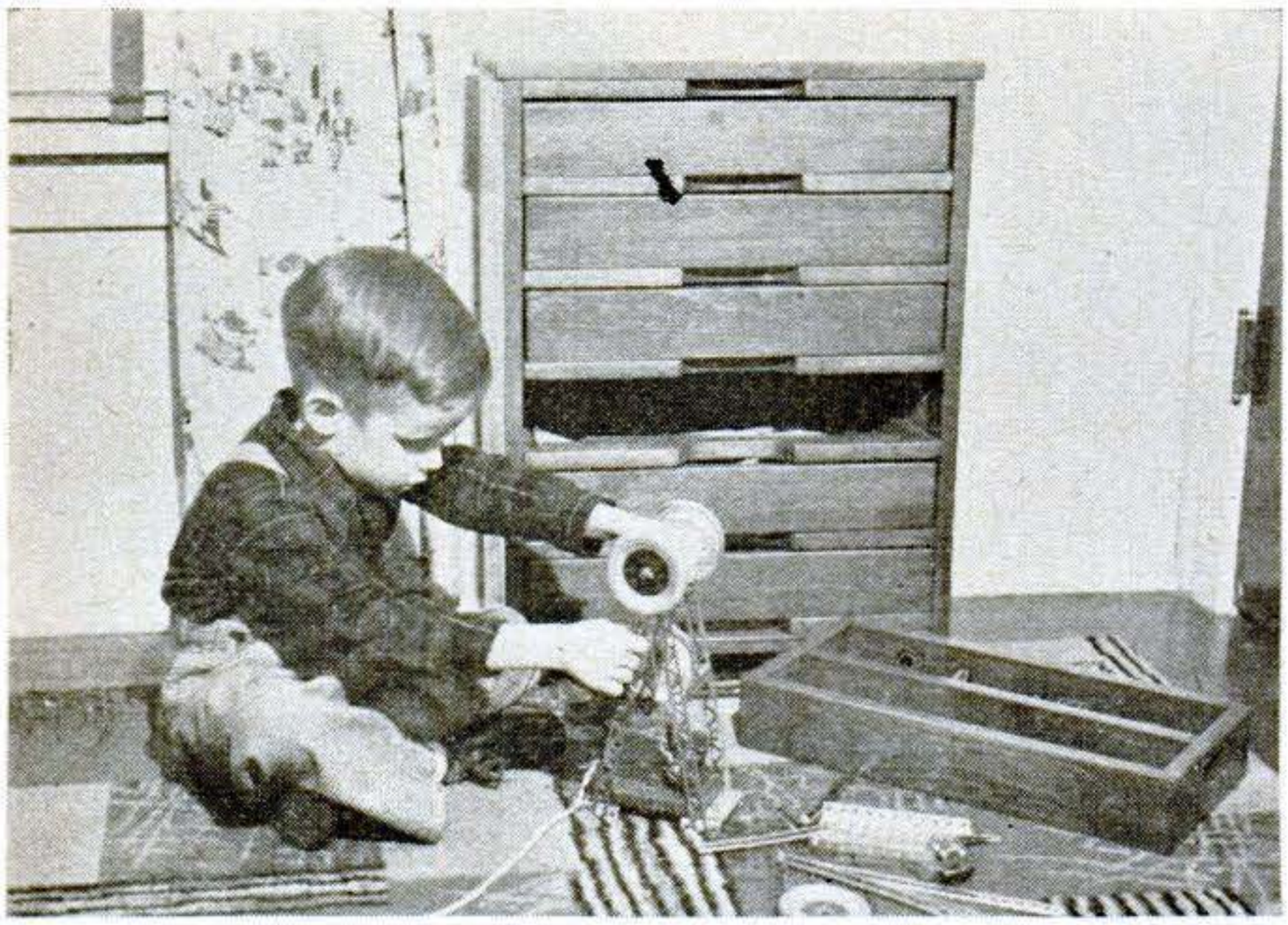
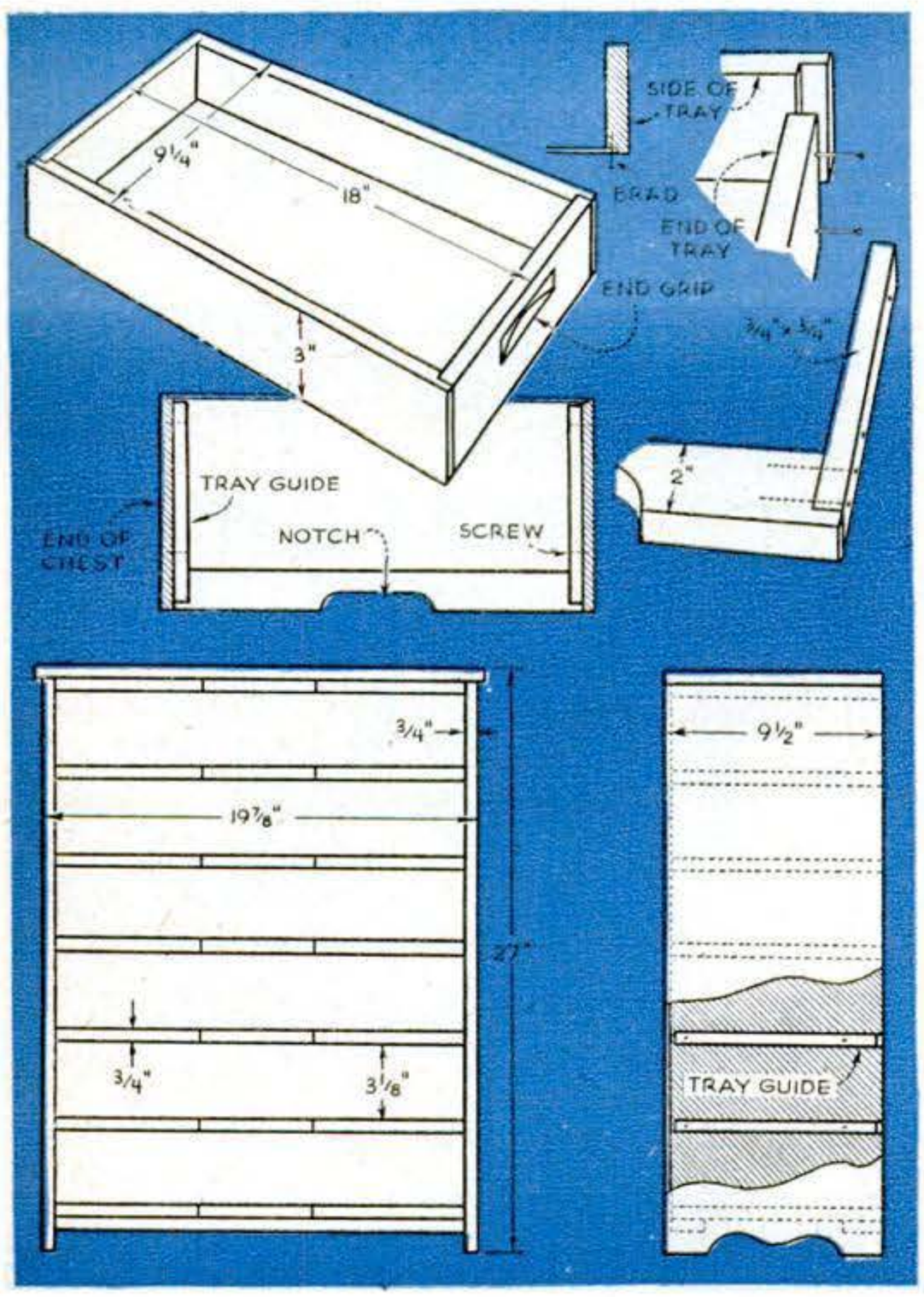


Building sets are more fun when no pieces are missing. Removable trays have side finger grips.

Photo above shows tray chest before back was installed. Tray guides are screwed to the sides.

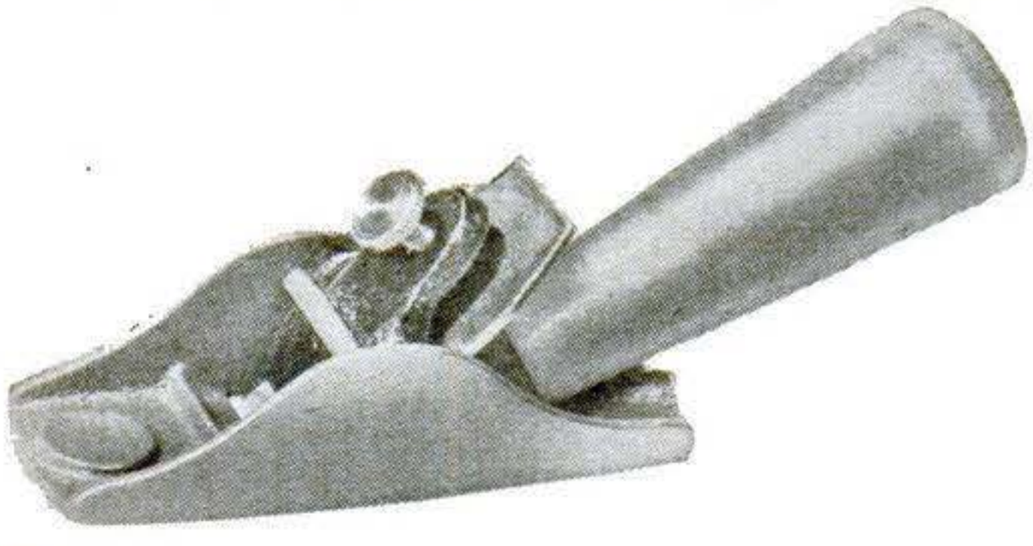


Tray Chest Keeps Toys Together

THE myriad bits and pieces of a youngster's construction set won't get scattered and lost so easily if you build him this playroom toy chest. Instead of drawers, it has six removable trays that may be slipped from the rack and carried to any part of the house. Lengthwise partitions of 1″ stock divide two of the six trays.

One-inch lumber was used for the drawer guides and the top and sides of the chest. Composition board makes the tray bottoms and the **back** of the chest. Number 7 wood screws **1¼″** long hold the guides to the sides. Rabbet **joints**, as shown in the drawing, are used at the corners of the trays. The back also is rabbeted in. For easier carrying, grips were routed in the ends of the trays. No knobs or handles were used, giving the chest a smooth appearance. Apply glue to all joints before nailing. Stain or paint the chest. *—Harold Jackson, Kankakee, Ill.*

Extension on Midget Plane Gives Good Grip



BY INCREASING the grip area through an extension handle, this small plane does the work of a larger tool, according to the maker, Sporting Goods Specialists, New York City. The tool is 1¼″ wide and 5″ long with a 2½″ extension grip and a heat-treated, forged-steel blade. It is sold by mail only for $1. Hobbyists and home workshoppers will find uses for this plane on numerous small jobs.

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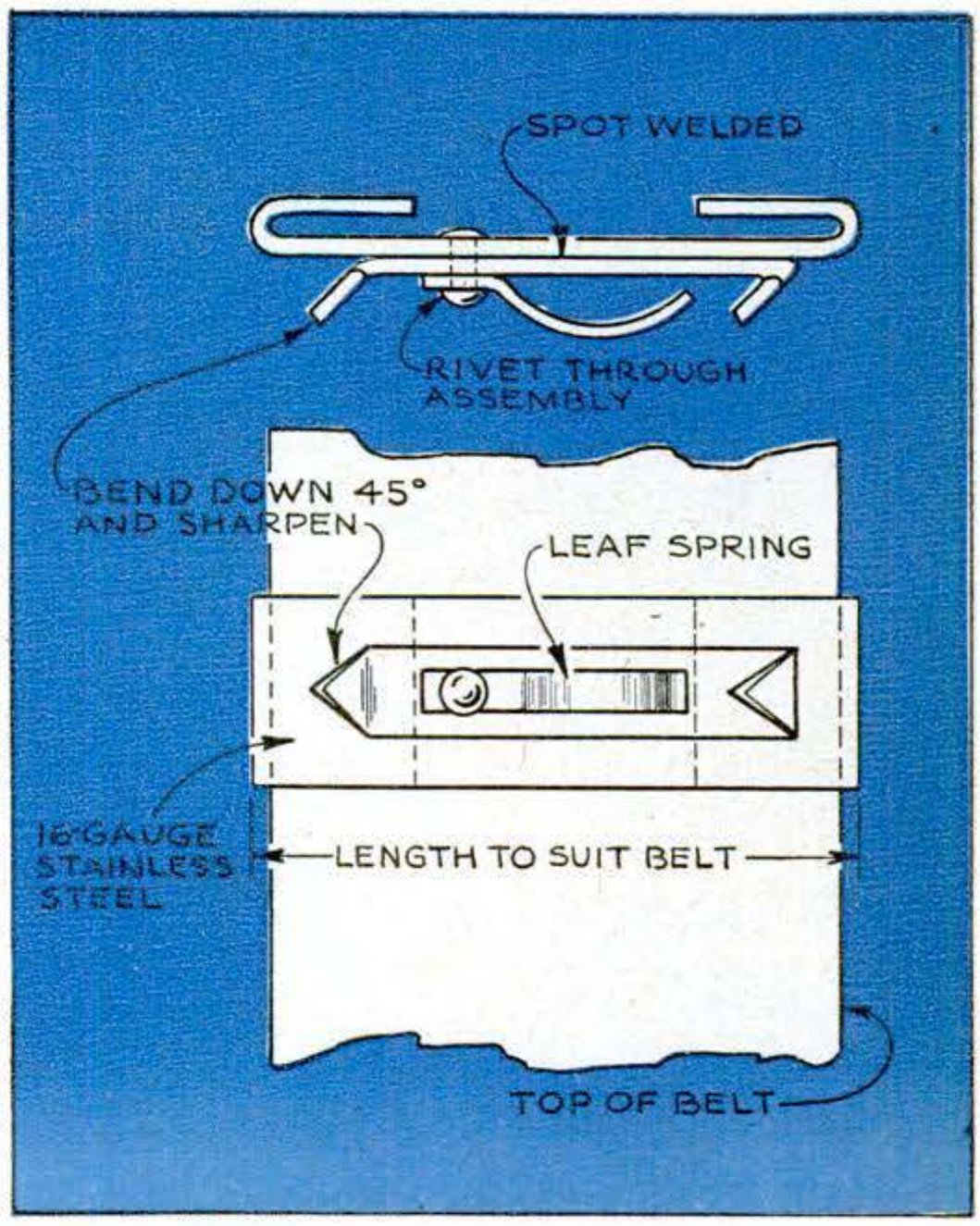
Steel Clip Aids Lineman

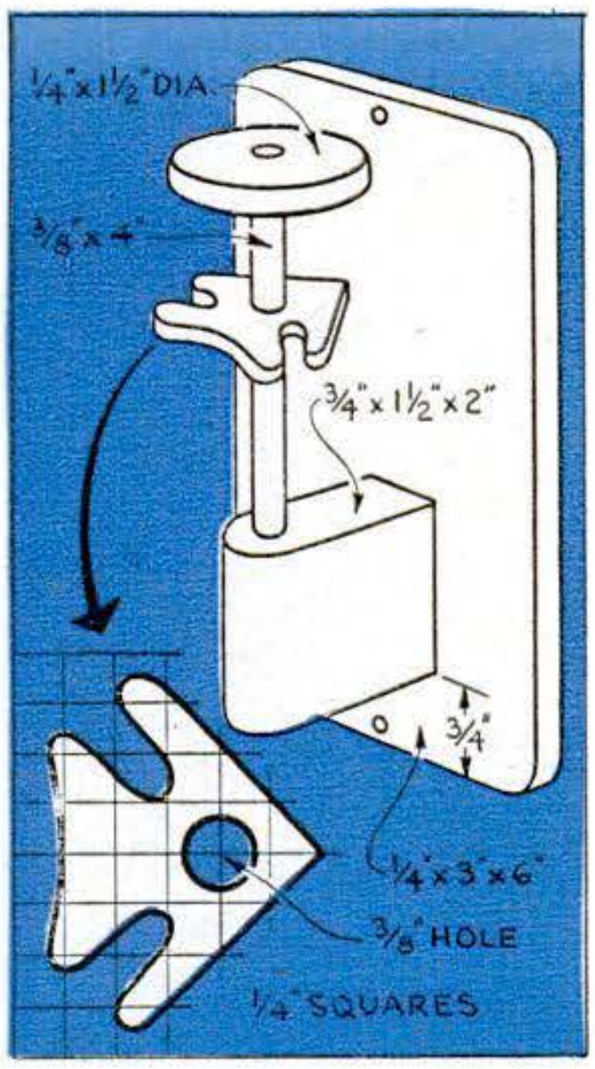
A SMALL steel clip, fitted over a lineman's climbing belt, will help prevent injury if his spikes slip. Should he start sliding, the points of the clip—mounted on the inner side of the belt—hold the belt to the pole and stop the fall.

All parts of the assembly except the spring are 16-gauge stainless steel. The clip was bent up first. The points were formed by sharpening the ends of a steel strip to chisel-like points and then bending them 45°. For strength, the strip with the points was spot-welded to the clip. Between the points, a short length of curved spring was fastened with a rivet through the assembly.

In use, the clip is set on the belt opposite the wearer. When the lineman leans back on his belt, the points are forced into the pole. When he relieves the tension on the belt, the spring releases the points.—*John Burroughs, San Francisco.*

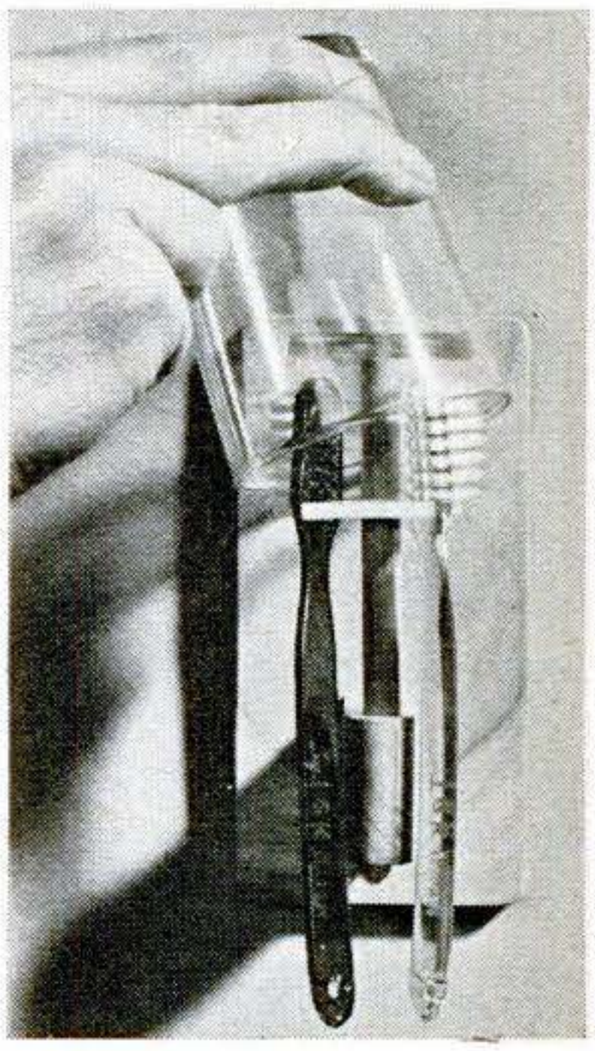


Toothbrushes and Holder Protected by Tumbler



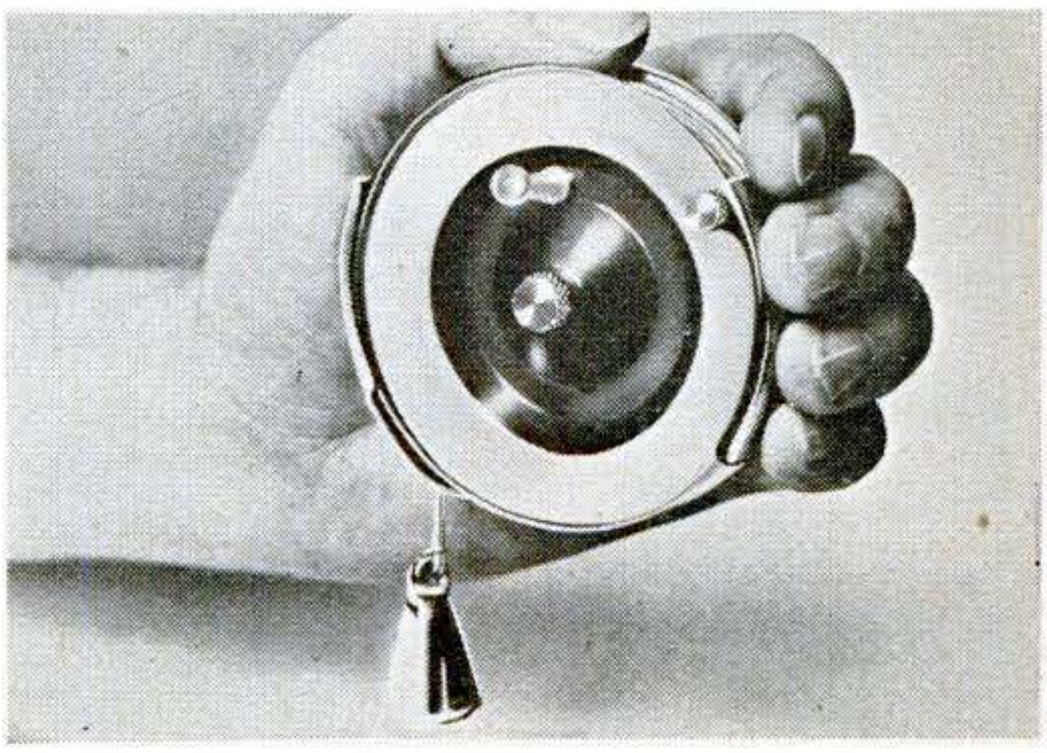
WHEN a tumbler is placed on this bracket, both your toothbrushes and their holder are protected from dust. Cut the parts from hardwood and stain or wax them before assembly. The part that supports the dowel is attached by two countersunk wood screws through the back. Both the brush rack and tumbler support are glued in place.

The entire project may be made of colored or clear plastic. One of the acrylics is ideal. Cement, of course, will have to be used to fasten the brush rack and tumbler support to the rod if plastics are used. To attach the dowel support, use two machine screws.—*Herbert C. Jones, Easton, Kan.*



Reel Holds Sounding Line

WATER depths to 100′ can quickly be measured with the Depthometer®. When the brake screw is released, a weight takes the line to the bottom and the depth is read on the line. Then the water-resistant line, marked at 1′ intervals, is reeled in and the brake reset. The maker, Depthometer Co., South Bend, Ind., suggests use of the reel by boatmen in checking the location of holes, channels, and bars. The body is chrome and the brake and axle screws are brass.



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How Experts Carve Solid Models

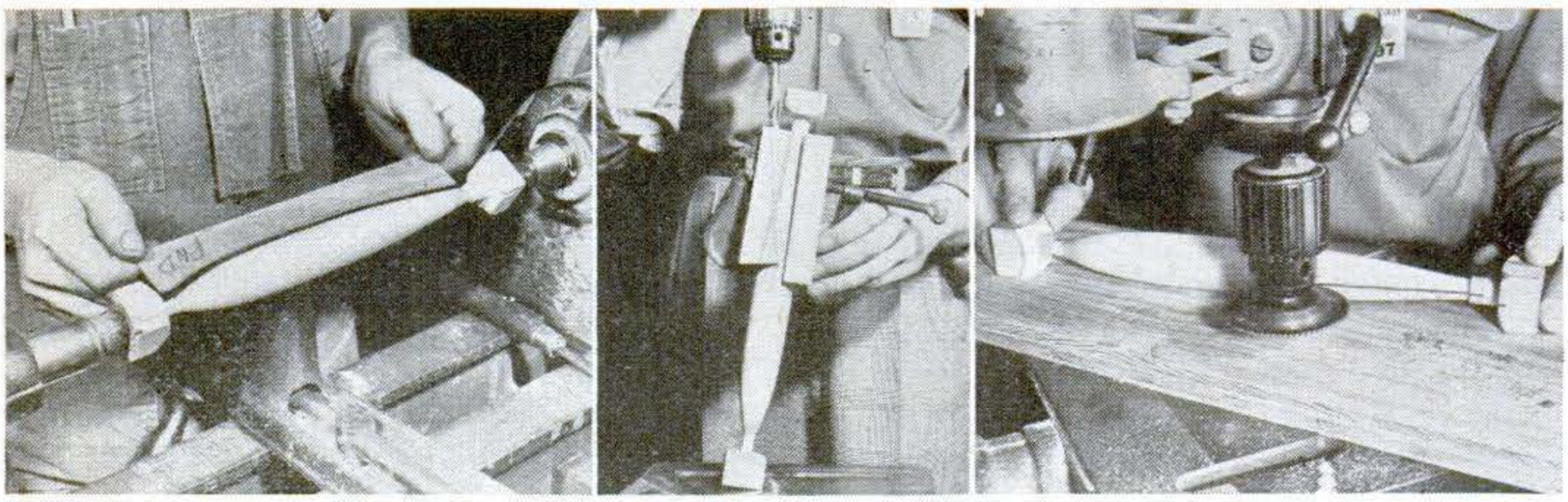
Sleek scale model of the famous Douglas Skyrocket looks as if it might speed off the stand.

EXPERIMENTAL planes usually take shape first as scale models, possibly in several forms. Though ornamental, their purposes are entirely practical. By examining them, engineers can clear up many design points long before the real plane hits the air. Aircraft companies call them discussion models.

Made closely to scale, these models demand the touch of an expert. And that's what you'll find in Douglas Aircraft's model shop at El Segundo, Calif., where the accompanying photos were taken. They show how craftsmen there make a solid wood model.

Maple is a favorite material. You might be inclined to choose one of the rare woods —ebony, cherry, or tulip. But the experts say no. Their reasons are simple and practical. Such woods cost more, are harder to work to a smooth finish, and must be painted, in the end, just as any other wood. Softwoods also are shunned; they bruise or break too easily.

Templates, made up from blueprints, are used to check all contours and lay out



Power tools speed up the job. While fuselage is being turned, contour is checked at intervals (left) with a template. Fuselage is held in jig (center) right, slots for are cut with a to drill jet exhaust ducts. At attaching the wings and tail slotting saw in a drill press.

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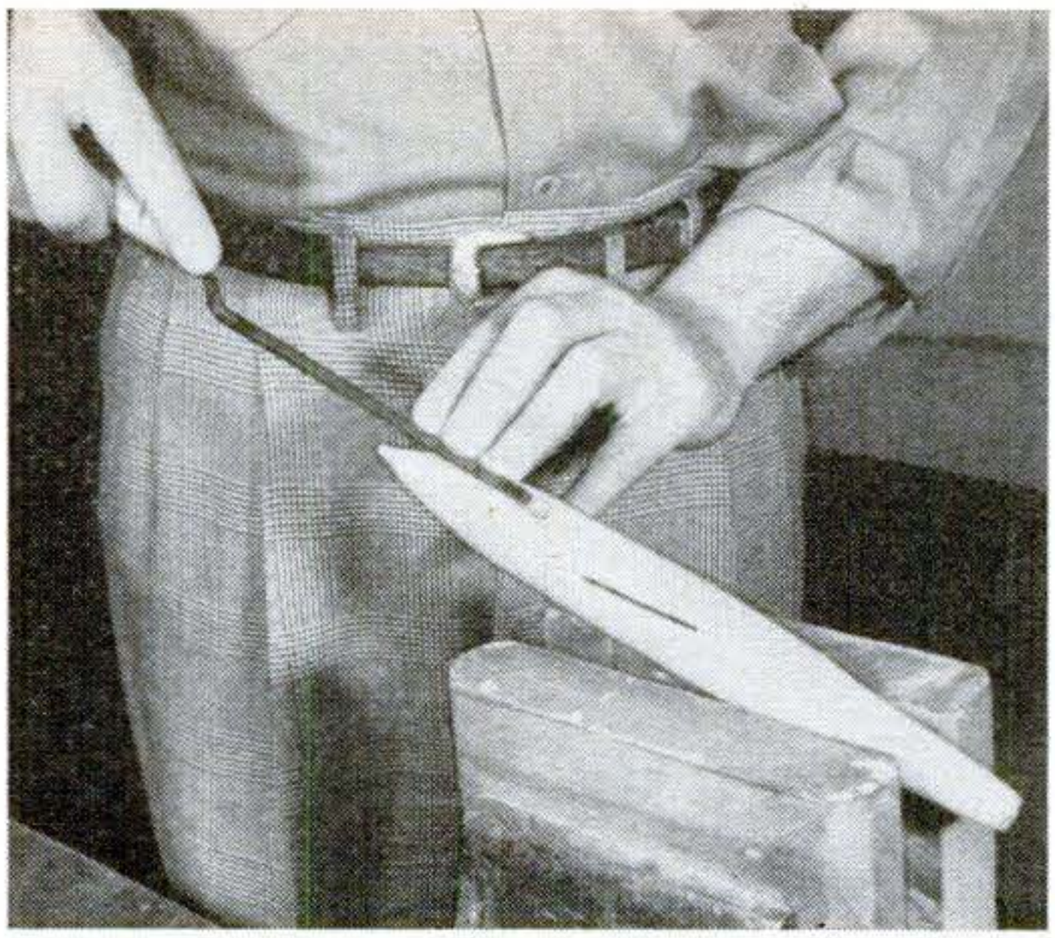
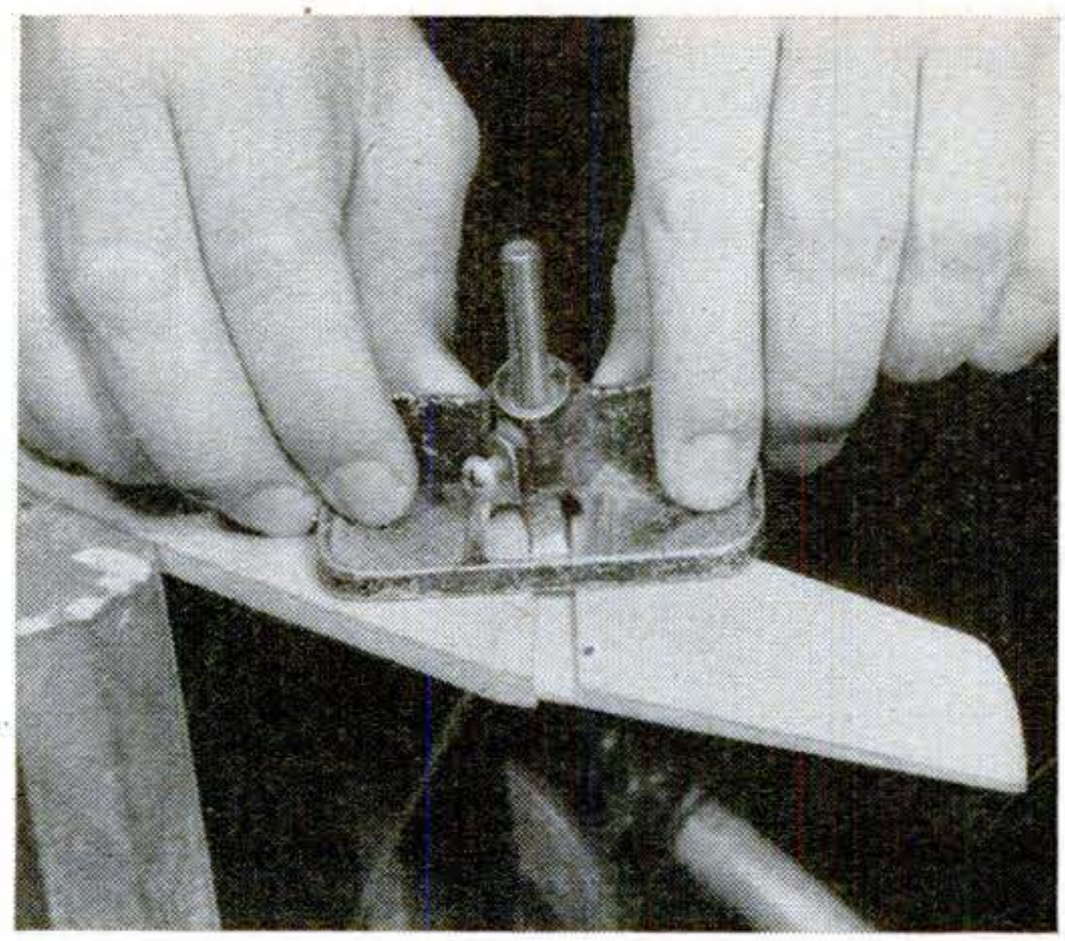
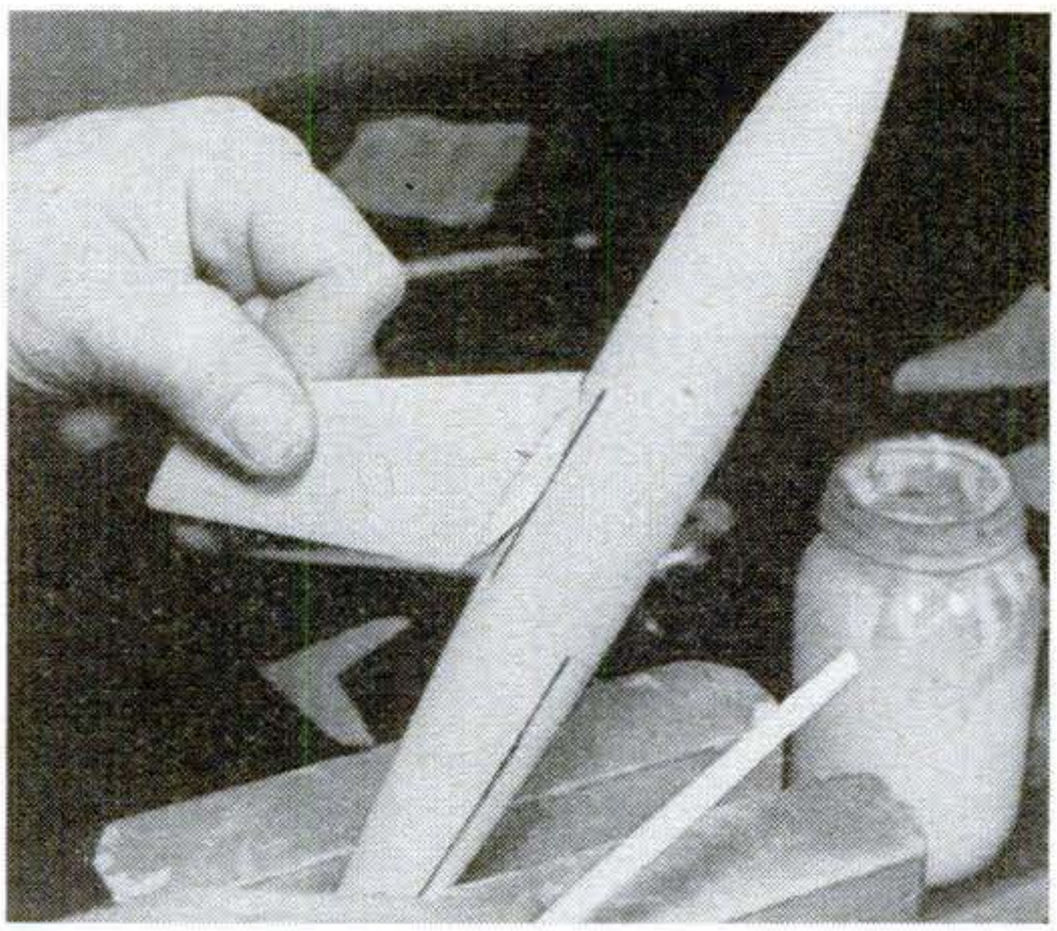


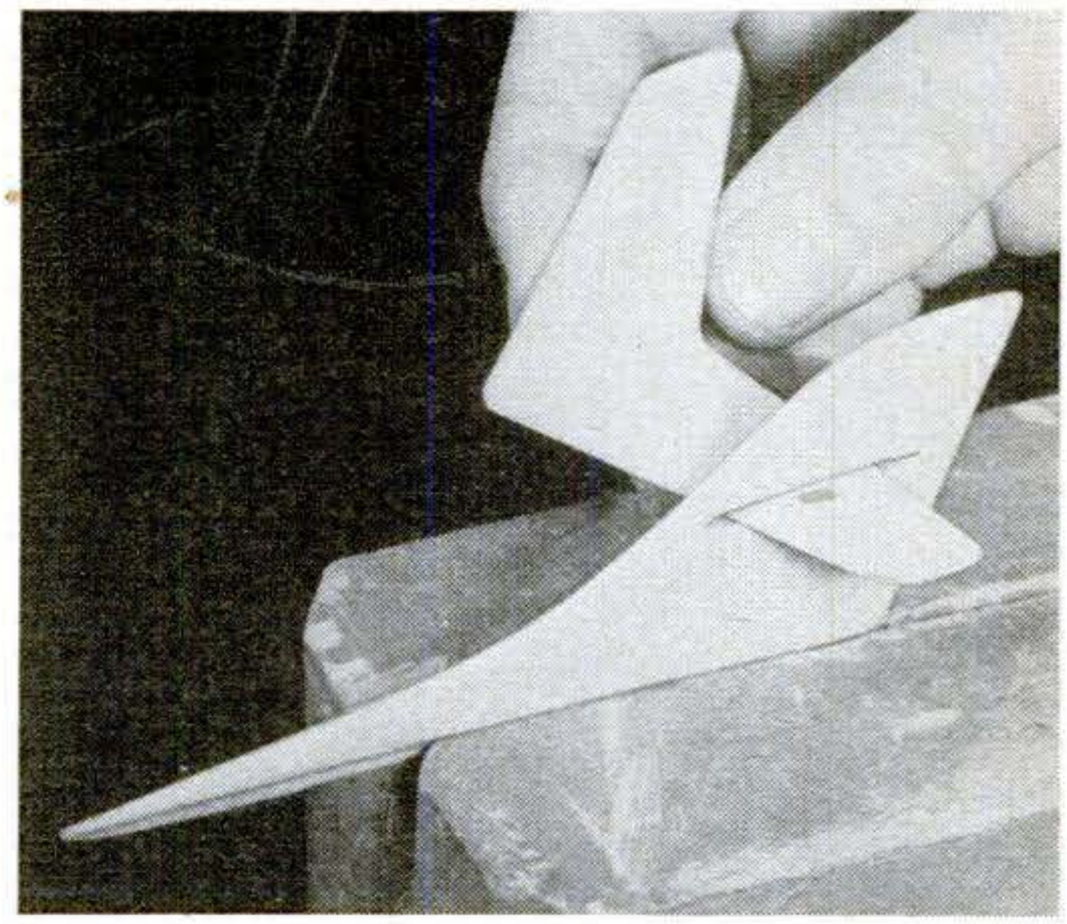
Air ducts leading to make-believe jet engine are chiseled out on bottom of model. Fuselage was sanded smooth while still on lathe.



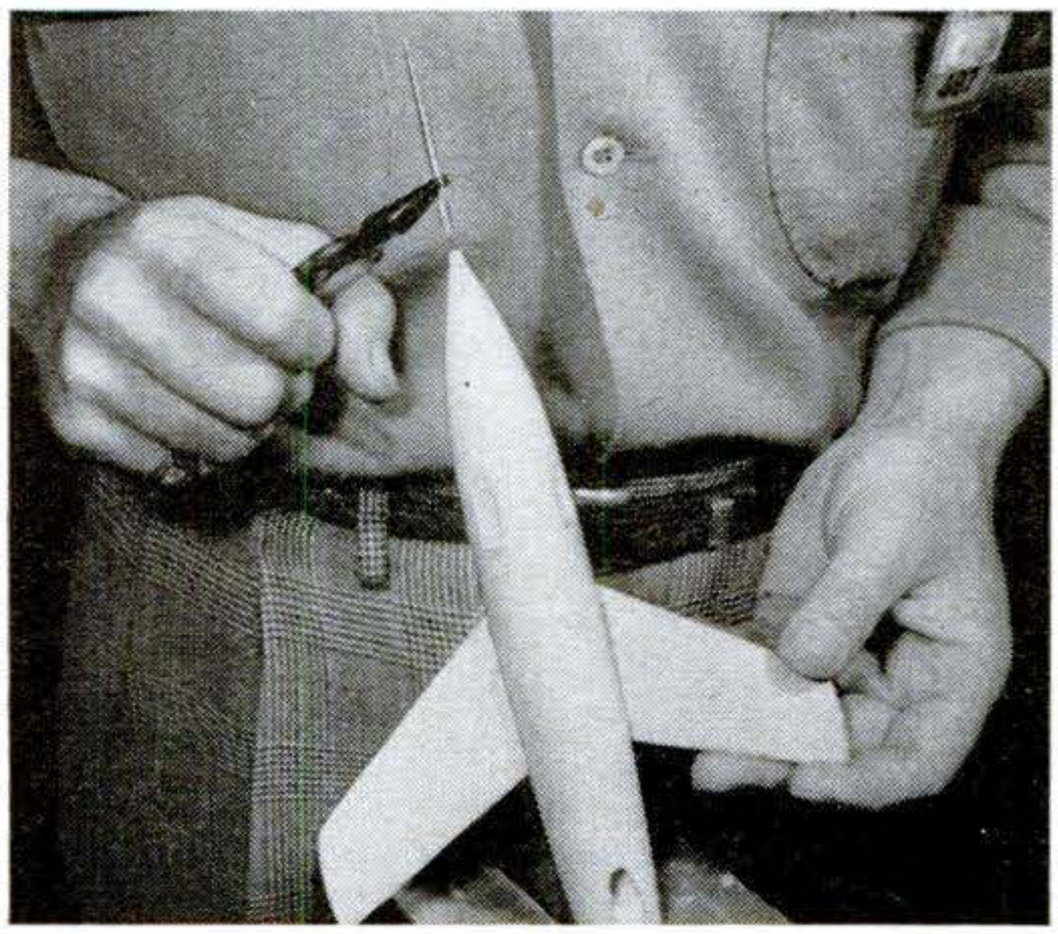
Roughed-out wing is dadoed as above, then cut off at the vise side of the dado. This thinned edge fits into slot already cut in fuselage.



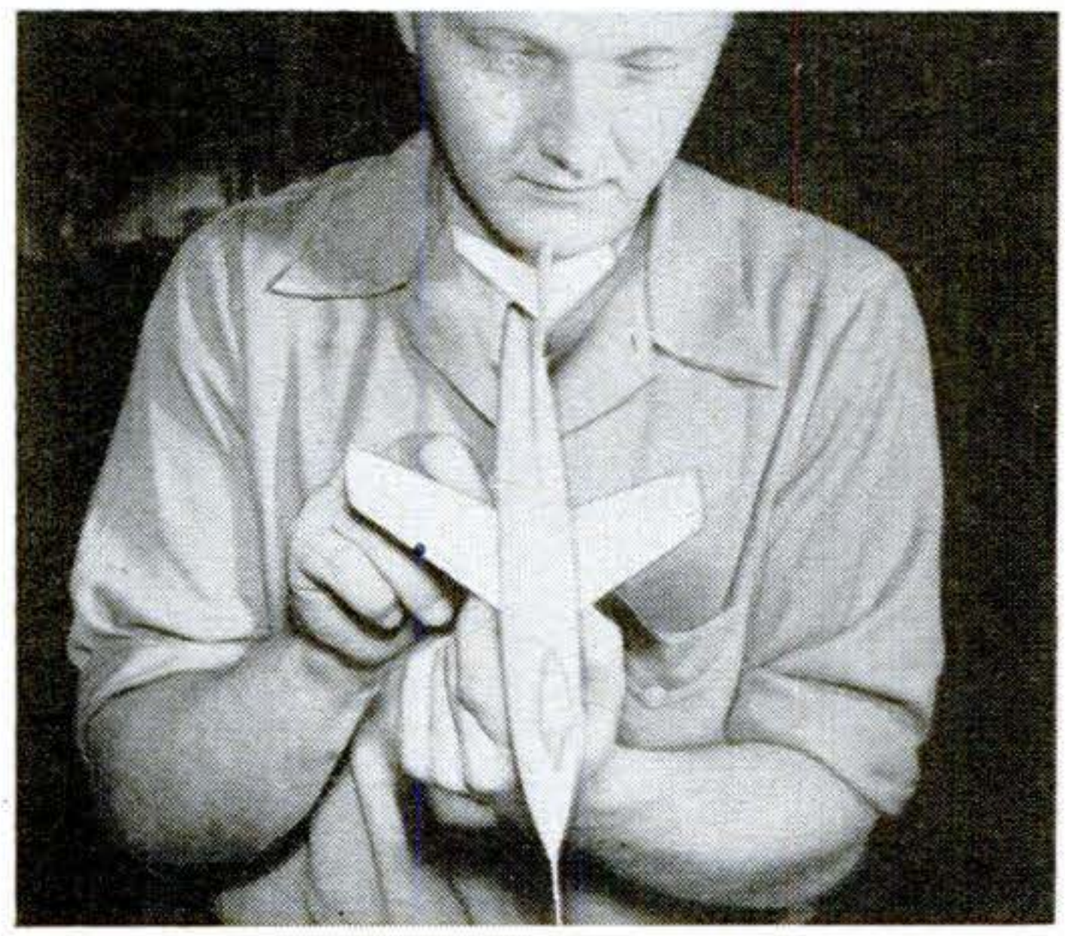
Wings are attached with a fast-setting glue, applied generously. They have been cut to the desired contour with a small spokeshave.



Horizontal stabilizer slips into a slot cut in vertical fin. The edges of both parts are faired off and all surfaces sanded before assembly.



A tapered nail minus its head is pressed into a drilled hole to form the needle nose. Model now begins to resemble its flying counterpart.



Alignment is checked visually before glue has had time to set. Pilot's compartment is a block of wood carved to fit fuselage.

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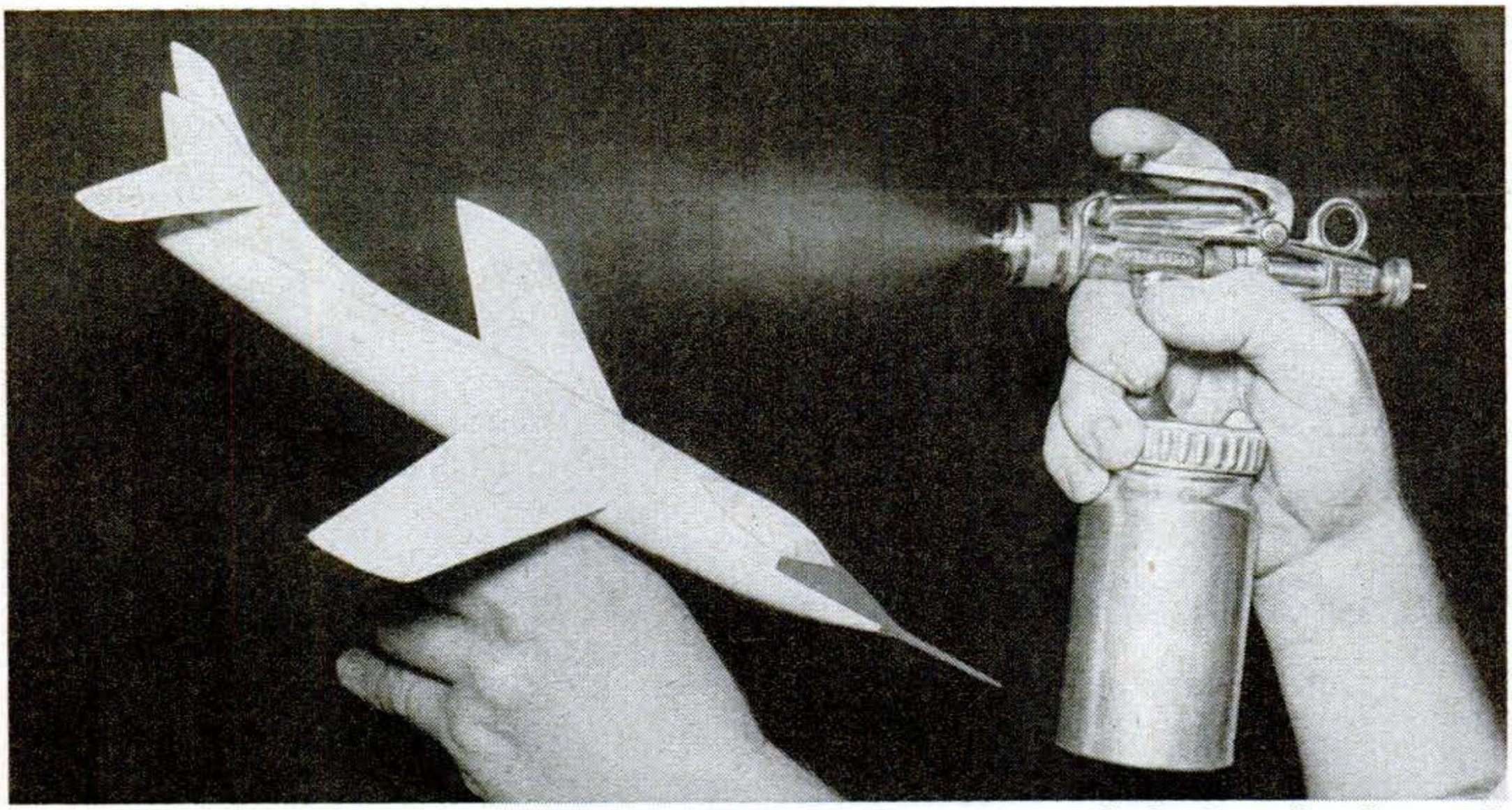
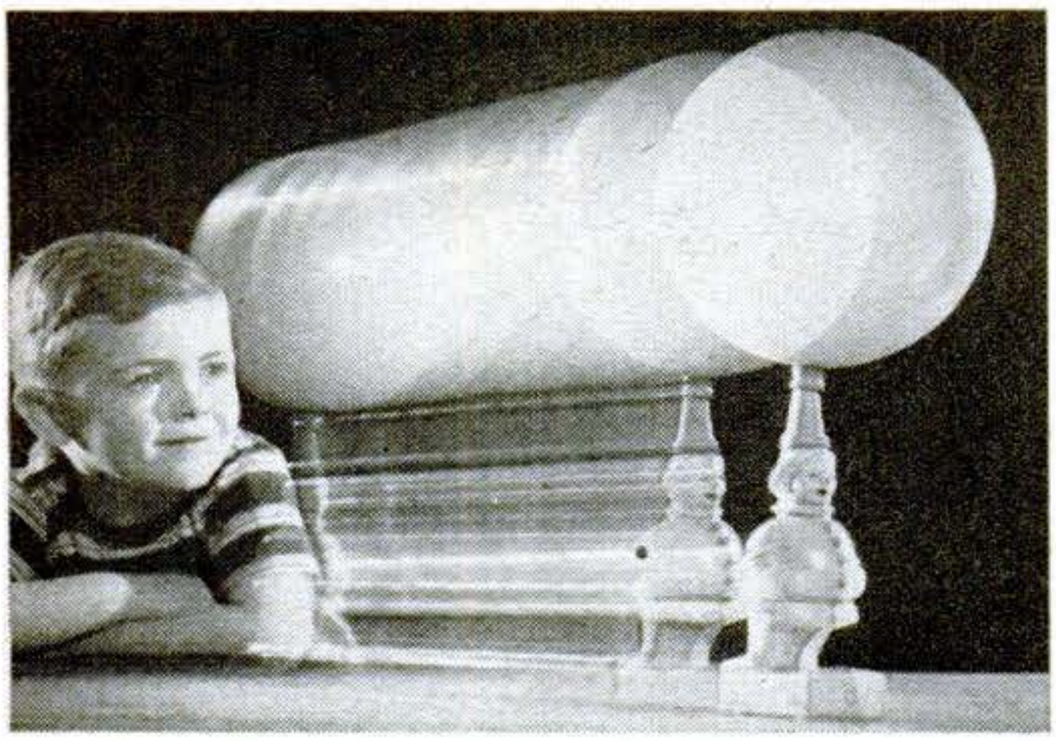


Finish coat of lacquer is sprayed on after the wood has been sanded and sealer applied. Note that nose area is masked. This is hand painted. Waxing, decals, and a stand are final touches.

parts. The Douglas craftsmen resort to power tools whenever possible, but quite a lot of the work is done by hand with carving tools, modelmaker's tools, and the like. Thorough sanding is considered important, for this is the basis of a good finish.

Insignia decals add realism to the models. These are the same as you can obtain from a model-supply store and are also to scale. It is well to remember that both Air Force and Navy insignia go on top of the left wing, underneath the right. END

Jet Balloon Propels New Toy



IT'S the age of jets—even in toys. Now comes a jet-propelled clown. Molded of plastic, the 7″ clown has rollers on its feet, a rubber balloon on its head. Inflated and released, the balloon speeds the toy along. Hobby Model Mfg. Co., New York, makes it.

Paint Roller Holds the Paint

WITH this fountain-type roller, you can forget about both brush and paint can. You simply fill the roller with any oil-base paint or enamel, and go to work. The paint seeps out through slits in the metal container and saturates a wool sleeve.

Made by the Paxtro Mfg. Co., of Detroit, the roller sells for about $3.50. The sleeve can be removed and cleaned. Additional sleeves are available if desired.

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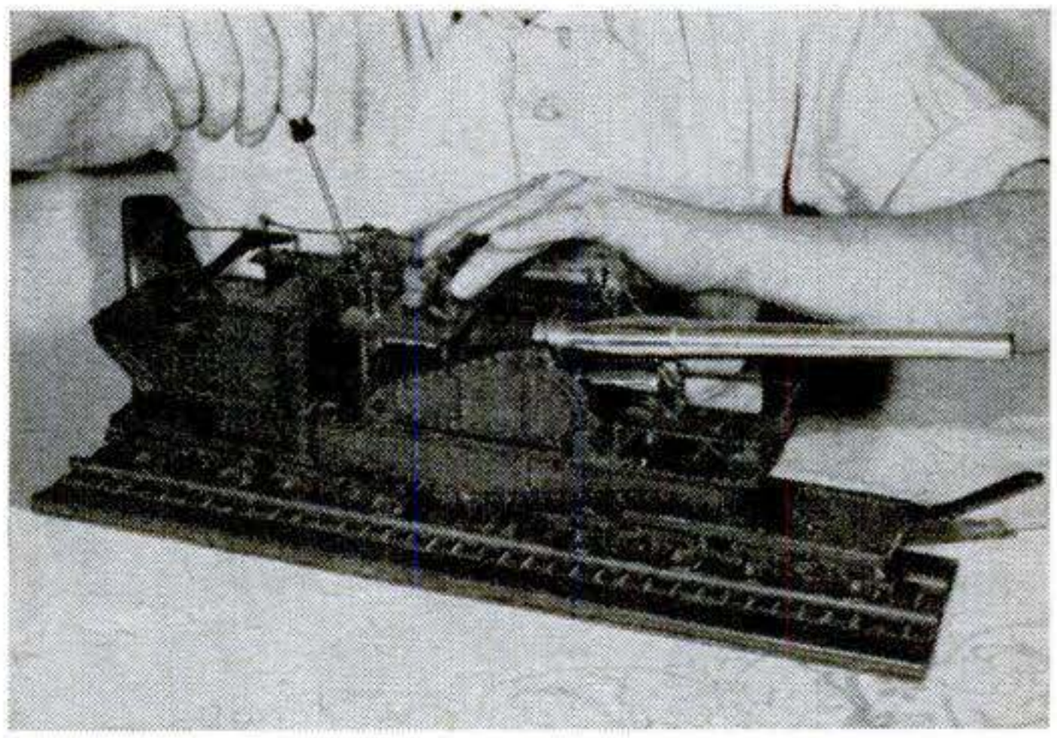
Dr. McKeen with four of his models. Replicas of baby grand pianos were carved from walnut.

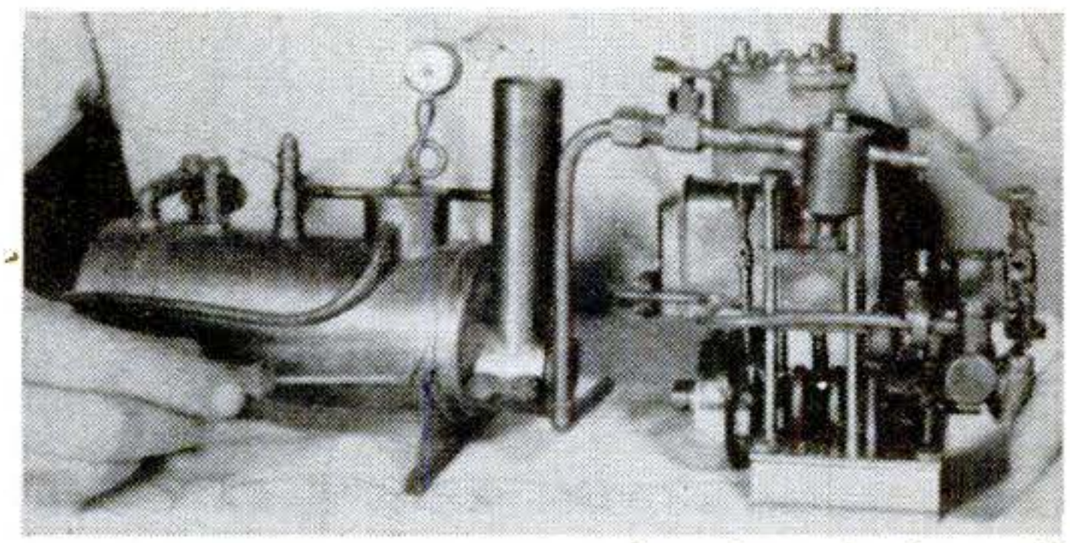
Dentist Builds Super Models

TURNING out unusual miniatures—from guns to grandfather clocks—is the hobby of Dr. Elmer McKeen, a Huntington Park, Calif., dentist. Among the models that have come from his workship to date are a scale replica of Big Bertha, Germany's World War I monster railroad cannon, tiny pianos, the boiler and engine of a tugboat, and naval guns. Music boxes in the pianos play when the keys are touched.



All mechanisms on scale model of Big Bertha operate. Flat car and gun are built of steel.

Finely machined miniature Navy guns will elevate, traverse, and fire off .32-cal. blank shells.



Duplicating in detail a real tugboat boiler and engine, this model has working pressure of 60 lb.

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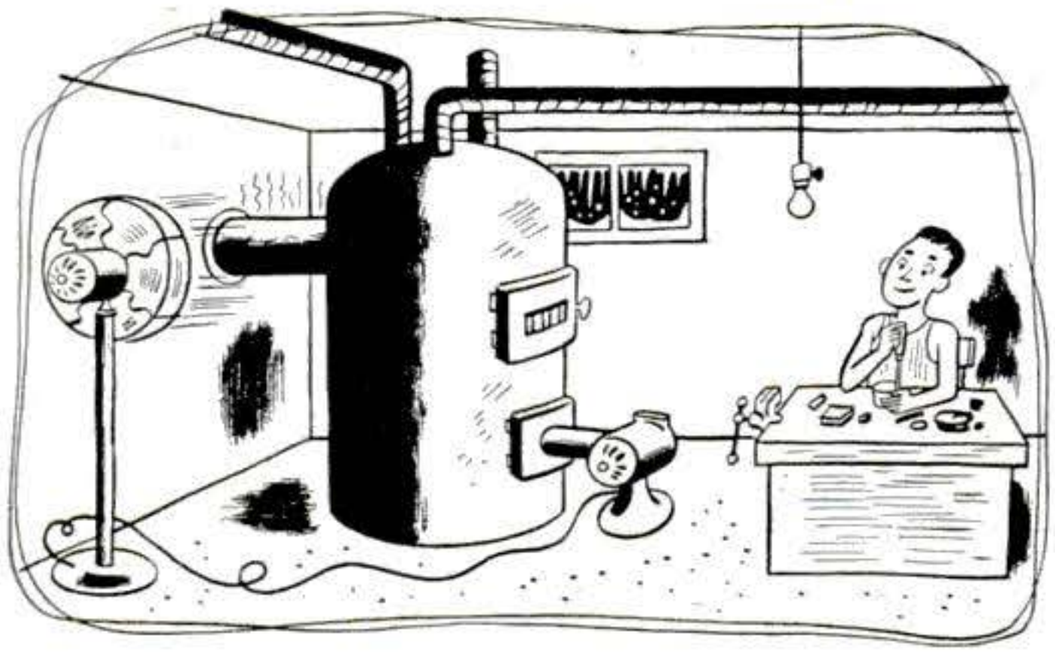
What's Your Ingenuity Quotient?



Flue Heat Prevents Flu. After insulating the heater pipes in my basement, I found I had done too good a job. The basement remained downright cold, threatening me with pneumonia. But lots of heat was still going out the smoke pipe. To save some of this, I wired a fan in parallel with the oil-burner motor and set it up facing the pipe. Result: a draft of air against the hot pipe each time the burner runs, and a comfortably warm basement at all times.—*Allen R. Coale, Silver Spring, Md.*

Measuring Inside Out. If you can't do a job one way, you probably can another. An outside micrometer isn't much help in giving a direct reading if you want to measure the diameter of a hole. But why do it the hard way? I shape a chunk of lead into a rough, oversize ball, tap it part way in the hole, remove it—and then take the measurement on the neck of the flattened ball. It's exact.—*H. P. Holland, Rockford, Ill.*

Double Cooker. My breakfast consists of coffee and soft-boiled eggs. To save time, I prepare both at once, simply by dropping the prewashed eggs into the coffee after the water has risen to the top of my automatic coffee maker. The bubbling time for the coffee is exactly long enough for the eggs. When the water goes down, the grounds keep the eggs warm until I'm ready for them.—*J. L. Graden, Toledo, Ohio.*

Let the Moles Beware! One end of a heavy concrete door step, resting on soft soil, had settled until its slope was dangerous. To raise it, I scratched a hole under it, stuffed in a deflated inner tube, and pumped up the tube. I then pushed dirt under the corners of the slab, deflated and removed the tube, and finished filling all around.—*George Voris, Elmhurst, Ill.*

Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works. Use government postcards only. Contributions cannot be acknowledged or returned.

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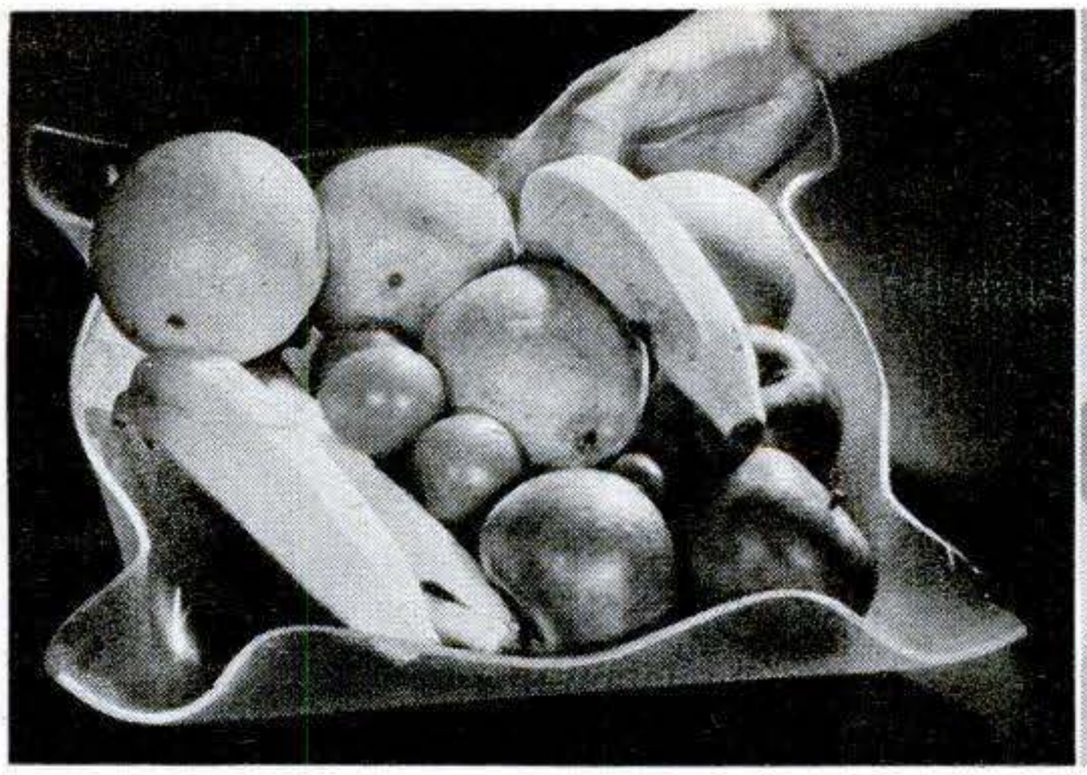
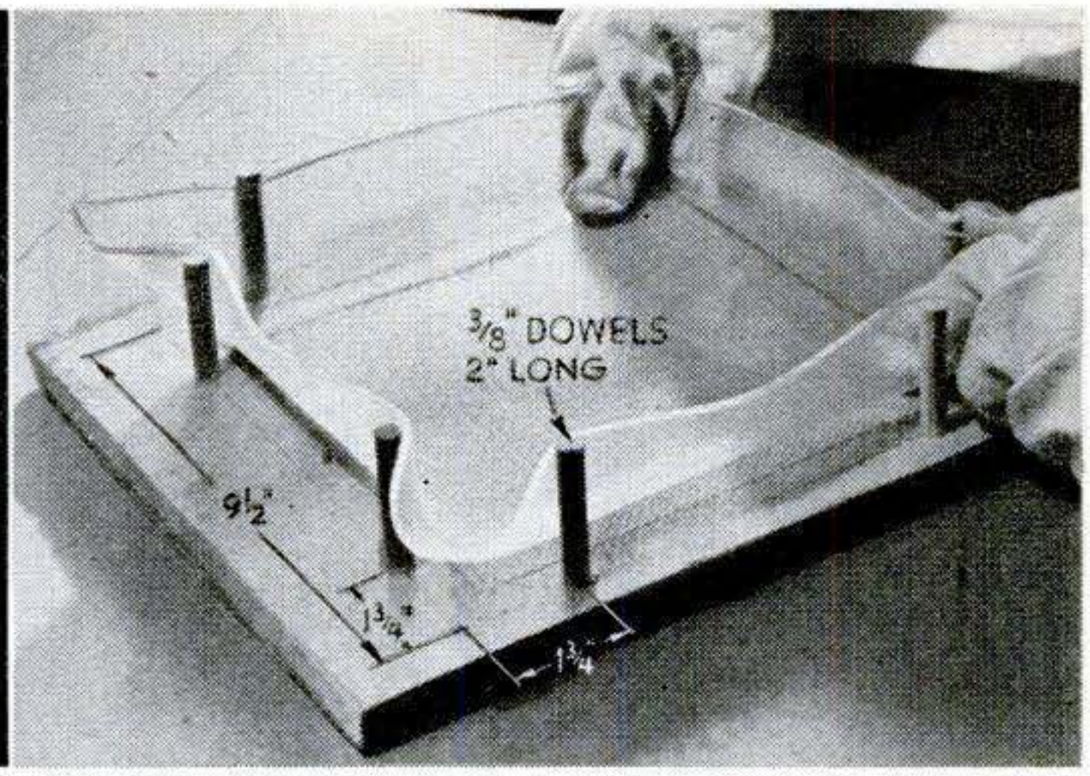


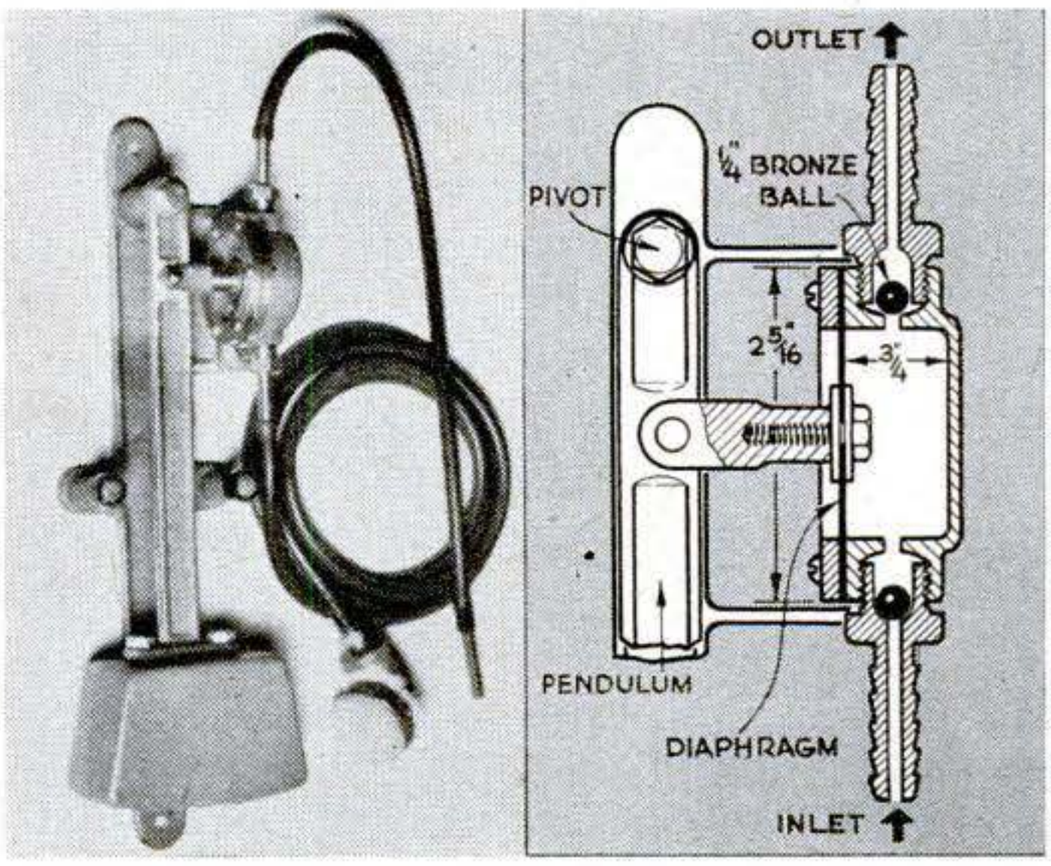


Handsome Fruit Bowl Shaped of Embossed Plastic

How fast can you drill eight holes in a board and set in short dowels? That's just about how long it will take you to make this fruit bowl. Virtually the only work done on the plastic is finishing the edges; you can do the shaping in half a minute.

A sheet of embossed ⅛″ Plexiglas® 12″ by 12″ was used for the dish shown. The textured surface is on the outside. Resembling pressed glass, it doesn't show scratches. However, any acrylic sheet ⅛″ to ¼″ thick can be used—either clear or colored.

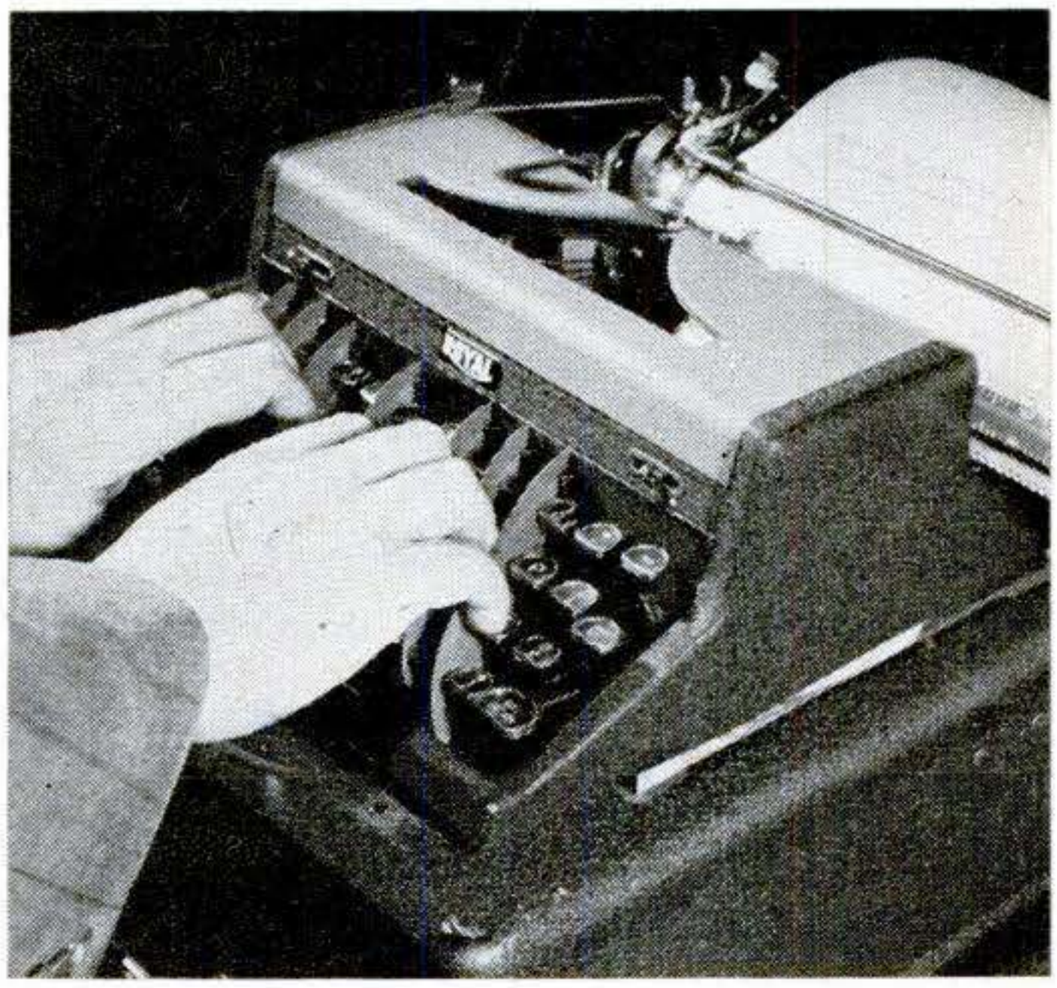
Drill holes in a wood base to the layout given, set in 2″ lengths of dowel sanded smooth, and the jig is ready. After polishing the edges, heat the sheet to forming temperature in an oven set at 275°. Then, wearing gloves, center the sheet between the dowels and pull the corners through. Gauge them by eye to make all corners the same size. Belly all sides outward an equal amount. Press the bottom flat and allow to cool. Polish the piece with wax or antistatic material.—*M. J. Moch, New York.*



Rocking Boat Pumps Out Bilge

While anchored or moored in any large body of water, a boat almost always rocks. A new bilge pump takes advantage of this. Rocking of the boat causes a pendulum to swing. From it a link pushes and pulls a Neoprene® diaphragm, forcing water out through two check valves. Under average mooring conditions, the pump is said to handle about 30 gallons in 24 hours.

Distributed by E. J. Willis Co., New York, the pump sells for about $22.50, including a strainer, tubing and fittings.



Typing Guide Helps Beginners

Here's a device designed to help beginners learn touch typing. Invented by Russell R. Potter of New York, it consists of seven plastic strips hooked to a metal strip that attaches to the typewriter body above the keys. The strips divide the keyboard into the proper sections for each finger. This forces the student to use the correct finger on each key and also helps him develop a straight downward stroke.

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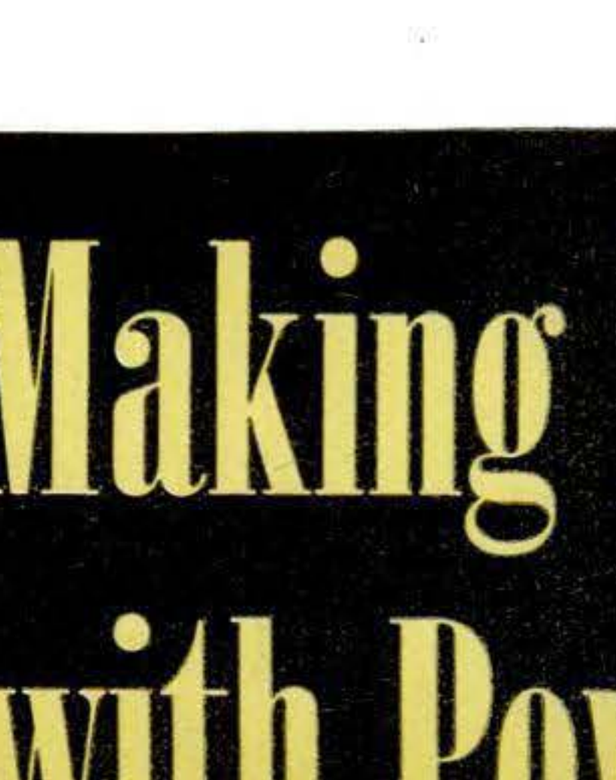
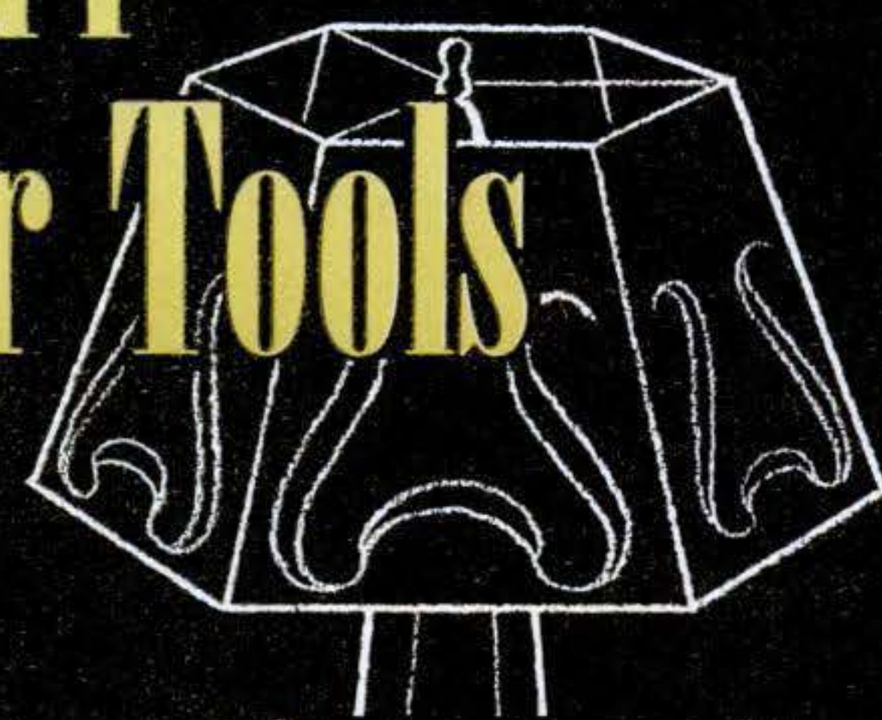
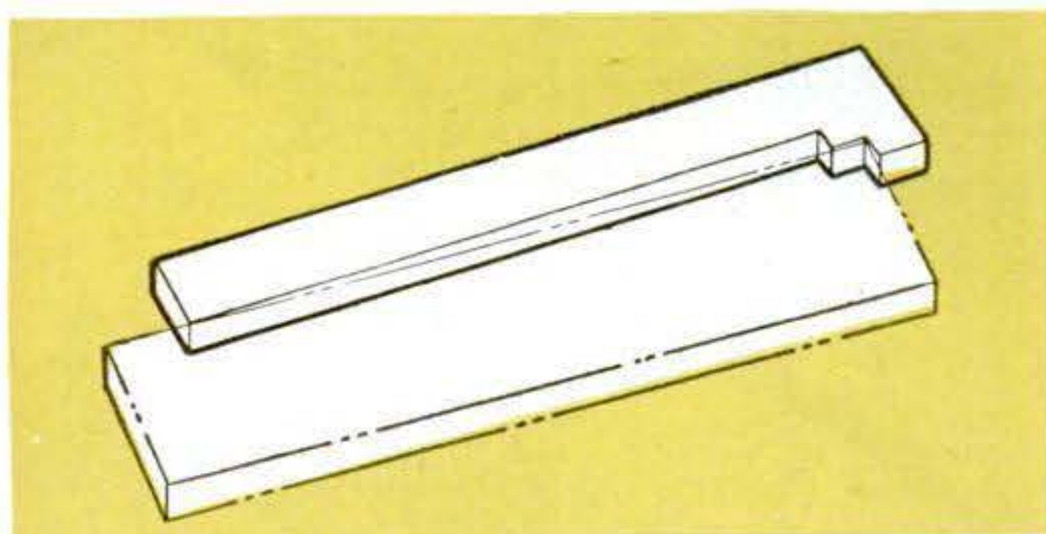
Making Hopper Joints with Power Tools

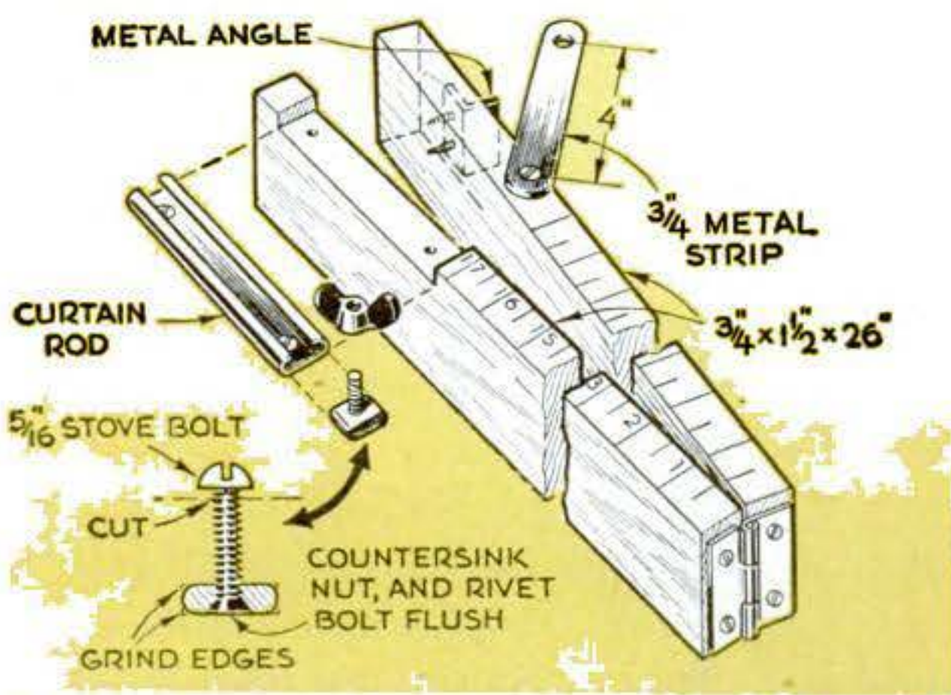




It takes some figuring to set table, gauge, or jig, but machines then make taper cutting rapid and uniform.



1. A notched stick is the simplest kind of tapering jig. However it's good only for one particular taper. Use it in production work.



2. Adjustable tapering jig can be set for any angle. Calibrate the legs, in half inches, measuring from the center of the hinge pin.

By Edwin M. Love

IF YOU consider tapering as a single operation, it's easy to see how machines take the labor out of slanting the edge of a board. Set the table, fence, or gauge, and the machine does the rest. But the real advantage of power tools lies in the fact that you hardly ever want a single taper, for one-legged tables and chairs are almost as rare as one-sided boxes. In practically every tapering job you have to make a number of identical cuts. One machine setting handles them all.

Tapers can also be cut freehand on a circular saw by following guide lines, but don't try it unless the board is large enough to keep your hands at a respectful distance from the blade. Holding devices aren't hard to make, and they speed the work.

The simple tapering jig shown in Fig 1 consists of a notched stick. It's fine for production work but the jig detailed in Fig. 2, being adjustable, takes care of any tapering chore. Two hinged legs are spread to a selected angle by means of a metal arm. Countersink one side of a nut for a 5/16" stove bolt, turn it onto the bolt, and rivet the bolt end flush. Grind the nut thin enough to

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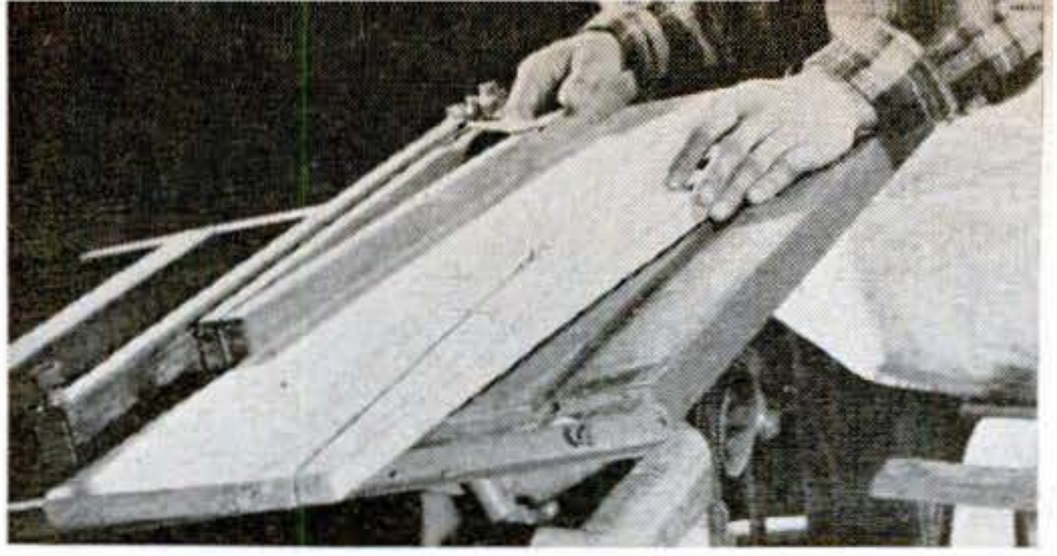
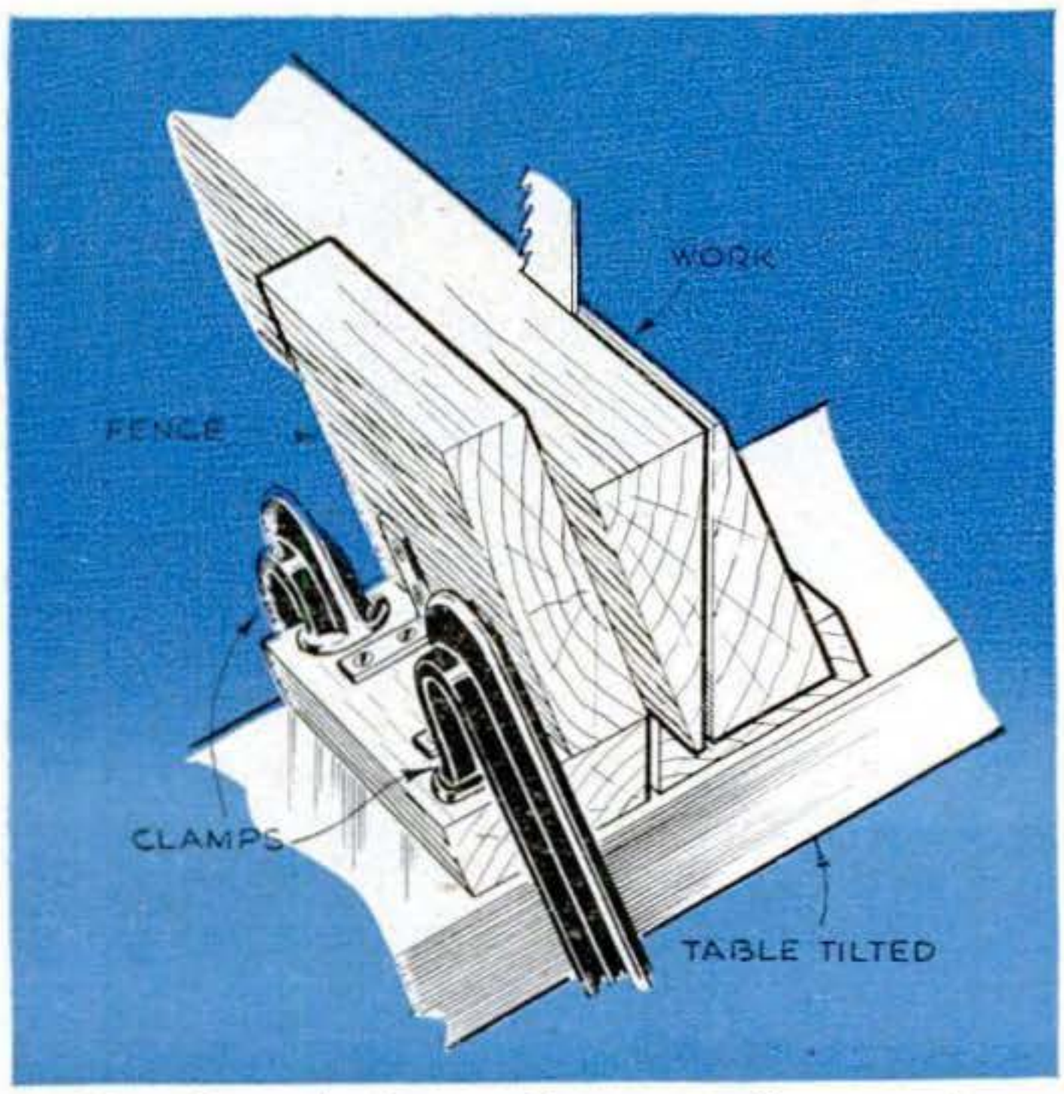
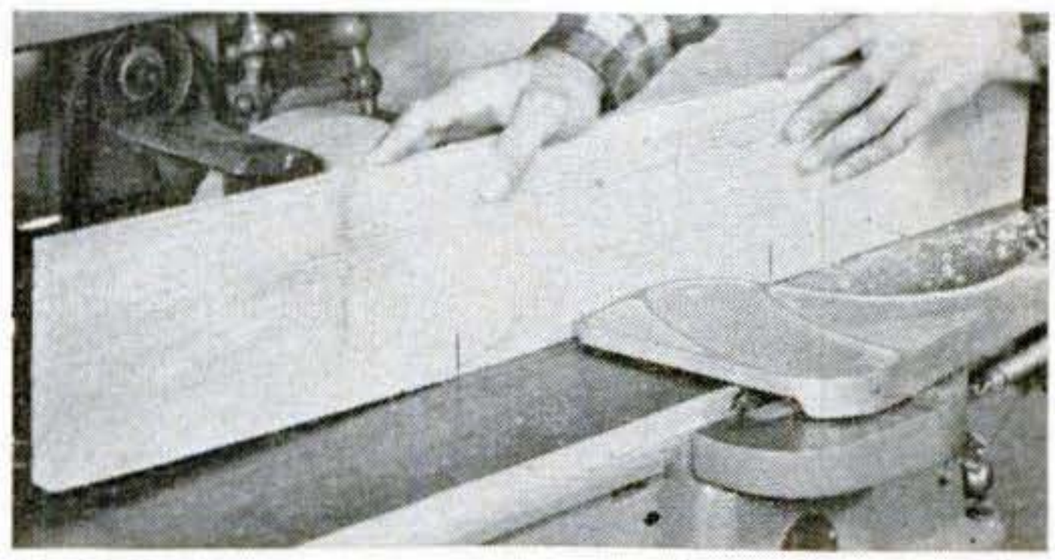


3. Adjust the saw fence and push the jig and work past the blade together. The tilted table shows that a compound miter is being cut.

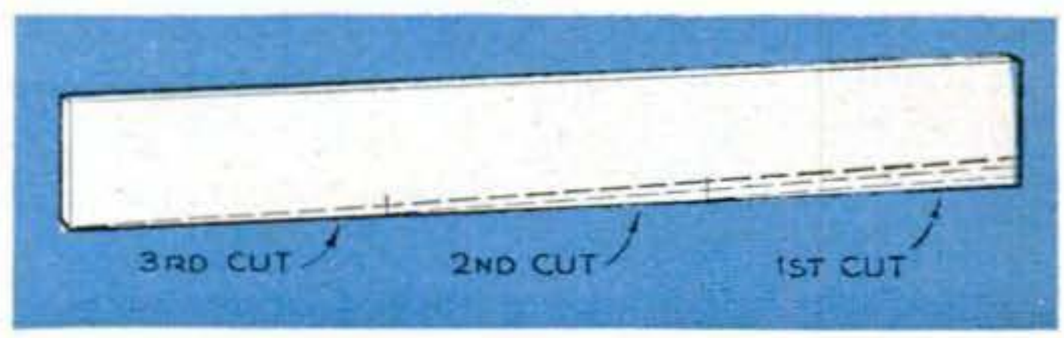
4. The shaper molds the edge of a board as it cuts a light taper. Start cut at the wide end, where little stock is removed.



5. Two boards fastened in a T shape make a wedge-cutting fence for bandsaw or jigsaw. Set up to allow for the lead of the blade.



6. Jointing a taper on a long board. The board is marked off into equal sections, each approximately the length of the infeed table.



7. For a three-section board, lower the infeed table by a third of the total taper. Make three successive cuts in the order shown.

slide freely in the curtain-rod slot. Cut off the bolt head and screw on a wing nut.

Set the jig by measuring between the legs at one of the calibration marks—usually the 12″ point. Adjust the saw fence to accommodate the jig and the board and push the two along the fence together (Fig. 3).

If the edge of a stave is to be jointed after being tapered, leave a little stock to be planed off in the second operation. When long boards are to be tapered, screw a longer auxiliary fence to the regular fence.

Just like plain ripping, tapering can be done with a bandsaw or jigsaw. If the machine lacks a metal fence, clamp a wooden one to the table. Be sure to make allowance if the blade tends to lead to one side.

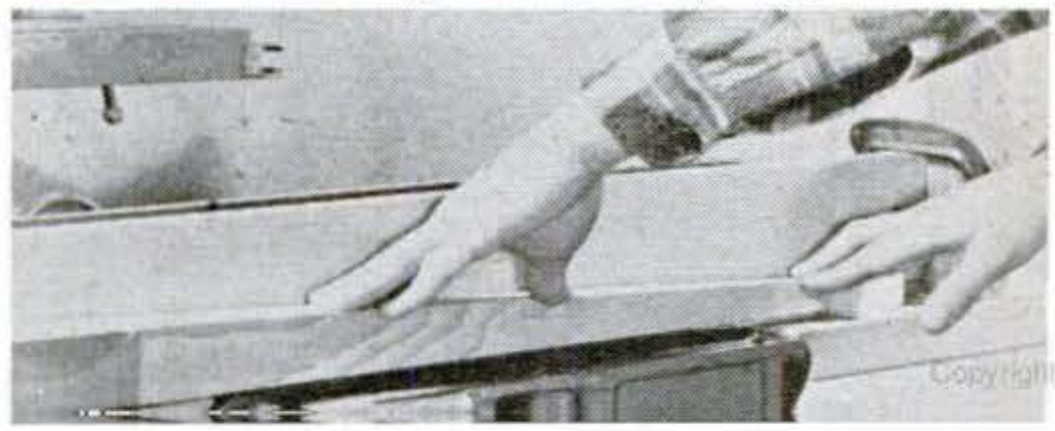
For slight tapers it's hard to beat a shaper because it joints as it cuts (Fig. 4). Since the jig and work must pass between the fence and the cutter, the regular fence can't be used. Clamp a strip of wood to the table.

A T-shaped fence (Fig. 5) is used for ripping strips of wedge section on a bandsaw or jigsaw. The bandsaw will cut the thickest stock of any power tool; use the widest blade available to help keep the kerf straight. Tilt the table and saw about halfway down the length of the jig to position the blade. Hold the work against the fence and push it into the blade.

The same job can be done without a jig on a circular saw by tilting the table, and then adjusting the regular fence close to the blade. The work must be held against the fence, so use the splitter to keep the wood from binding.

The method of tapering a board on a jointer is shown in Figs. 6 and 7. Divide the board into two, three, or more equal sections, each approximately the length of the infeed table. One divided into two stages is tapered in two steps. The inner table is

8. Tapering a table leg on a jointer using an extension table. Here a second pass is being made to clean up an already tapered side.



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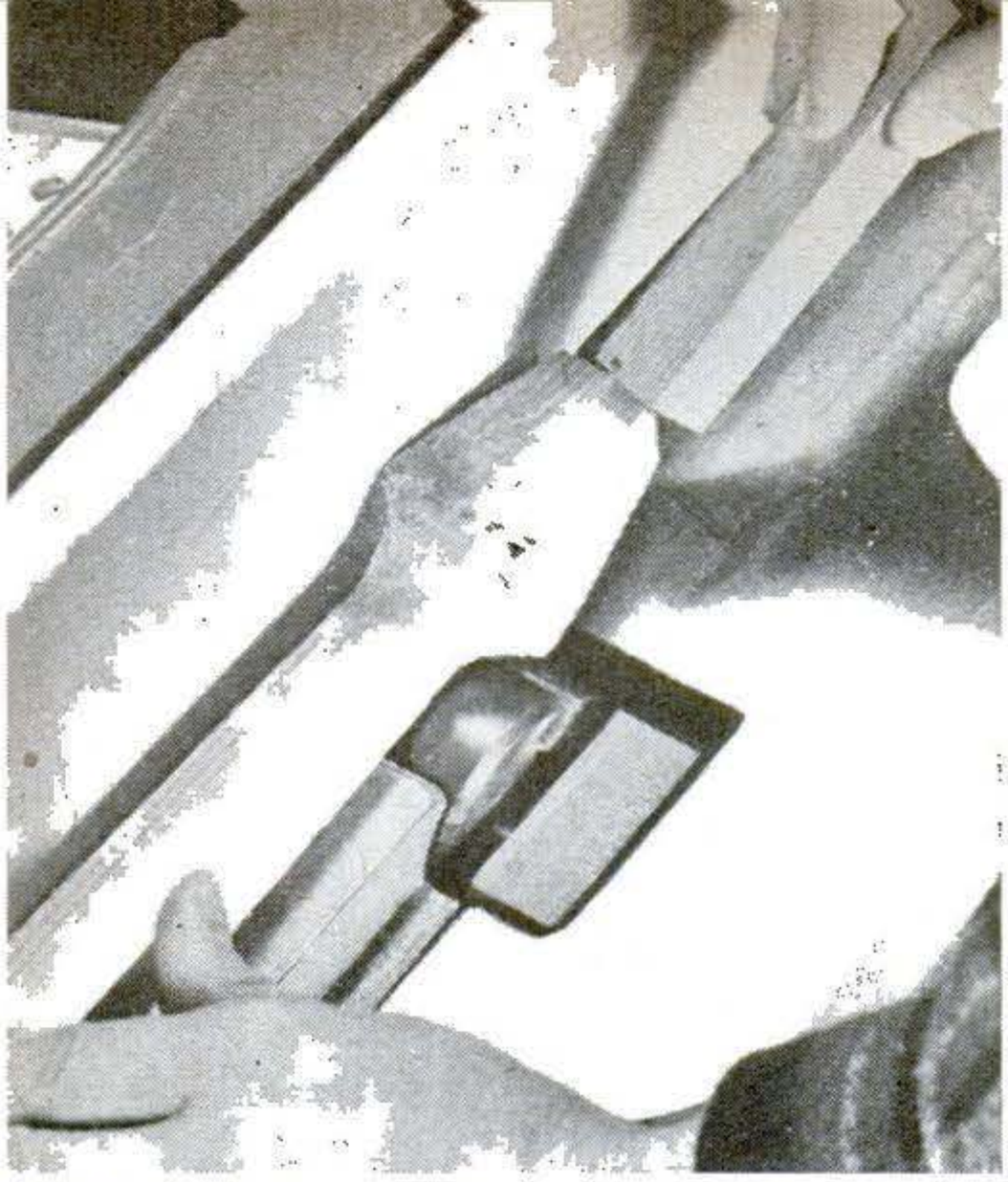
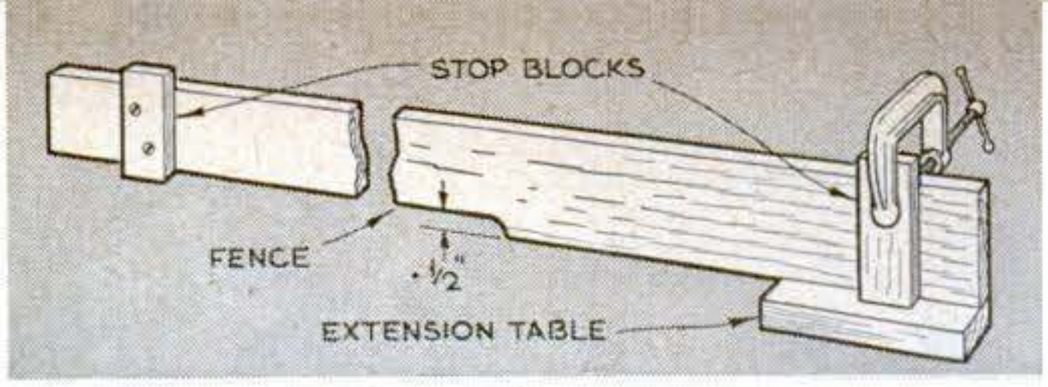
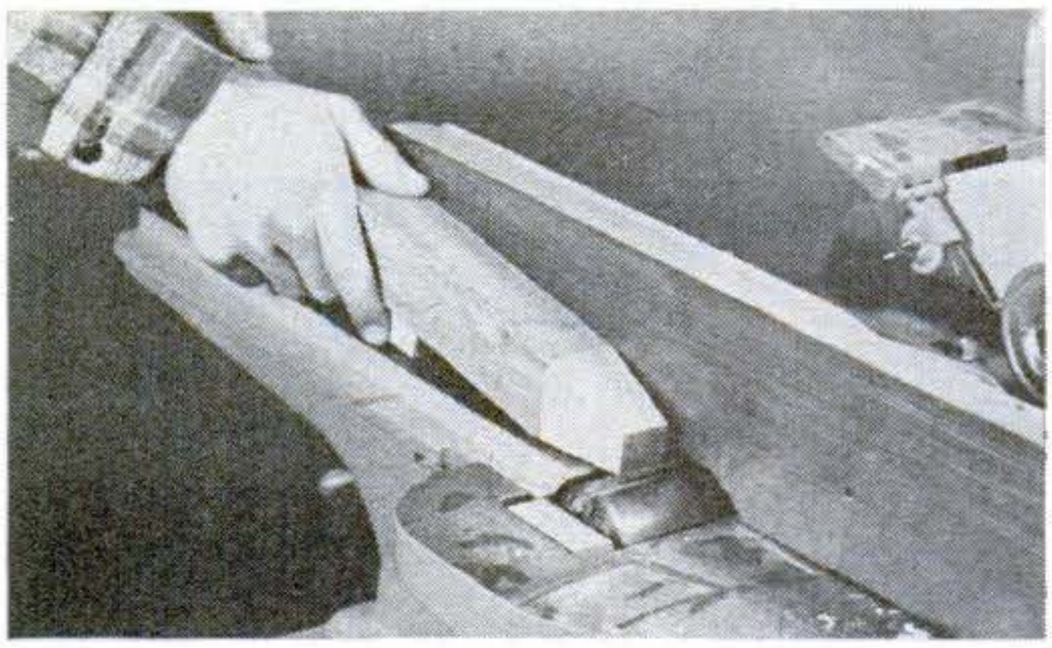


9. End of the tapering stroke. A push stick is used for safety. The piece is stopped by a block clamped to the far end of the table.



10. Extension fence for one-pass tapering on a jointer is screwed to the machine fence. The stops can be either screwed or clamped on.



11. In forming a leg, taper the foot first. A block tacked to the work rests on the outfeed table and supports the piece at correct slope.

lowered one half the total taper. The near section is cut first and the second cut is continued through the first. If an extension table is built for the jointer, a long board can be tapered in one pass.

The jointer tapers square table legs nicely. Since the taper is usually slight and it is handy to make one pass per side, an extension table should be used. A kick block attached to the extension eases the start of the cut and helps gauge position.

Figures 8 and 9 illustrate the tapering of a leg on which a foot is left. The start of the cut demands a kick block, while a stop at the far end prevents cutting into the foot. The long extension fence detailed in Fig. 10 carries its own extension table and stop blocks.

The first step in forming the leg is to taper the feet. Tack a block to the side being tapered at a point where the block will rest on the outfeed table while the end of the leg rests on the infeed table. A steady backward pull does the rest (Fig. 11). Even though there's a good hold, use a kick block.

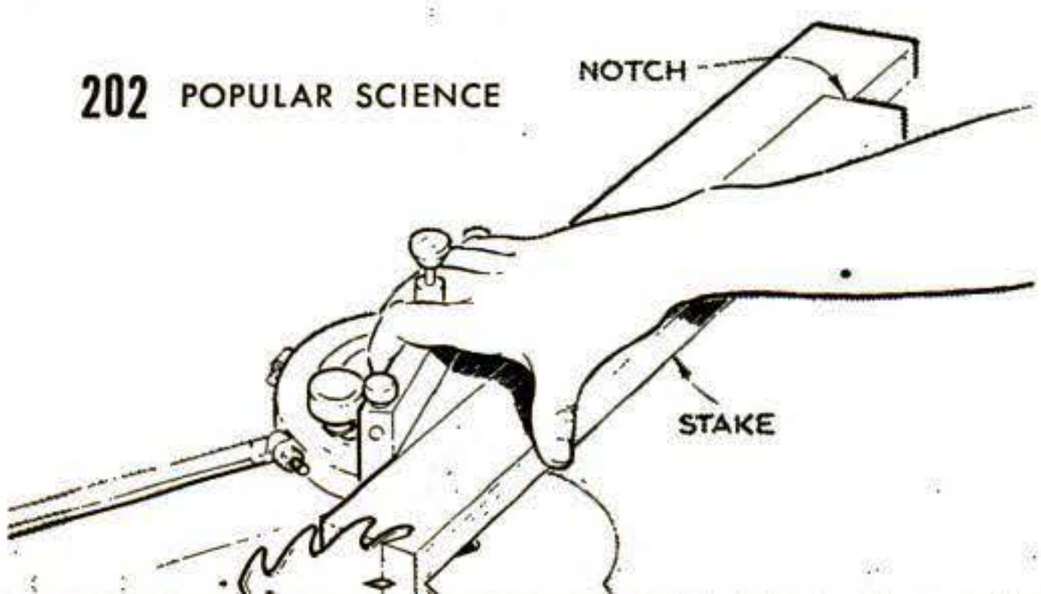
A dull blade or wood that splinters easily calls for precutting the coves at the top of the foot. Do this either by sawing or by a recessing operation in which the foot is dropped over the cutter from the infeed side. Set the stop block to limit the tapering cut just short of hooking into the top of the foot.

A stake-pointing jig is shown in Fig. 12. It's simply a notched strip tapered at one end and screwed to the miter gauge. The stake or picket to be pointed is set into the jig notch and pushed past the saw. Turn the piece over to cut the other side.

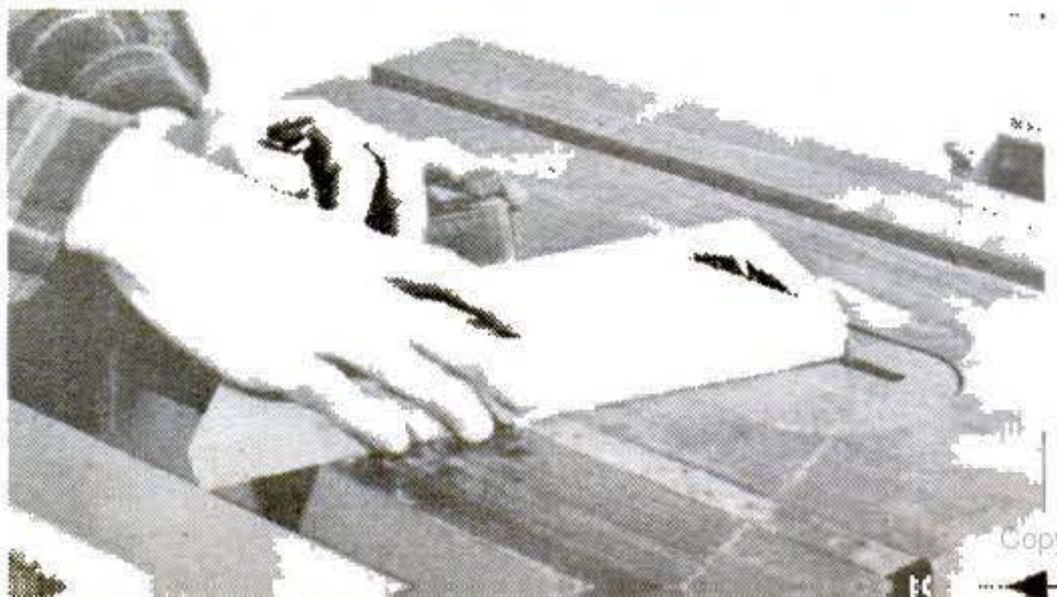
Figure 13 illustrates the cutting of a compound miter for a hopper joint. There are two basic ways of arriving at the proper machine settings. The more orthodox (though not necessarily the easier way) involves the steps pictured in Fig. 14.

Let's assume you want a tapered column 24″ high with a slope of 4″. First step is to calculate the angle represented by a slope of 4″ in 24″. One method of doing this is illustrated in steps A, B, and C. The figures are reduced to more manageable units of 2″ and 12″—the angle being the same. On a straight-edge board or paper carefully lay off the height and slope. Draw the diagonal and

12. Stake-pointing jig is a notched stick. Set miter gauge at 45°. For convenience, the gauge is pushed backward past the saw.



13. In compound miter the miter gauge (or tapering jig) is set for the face slope and the table is tilted for bevel through the thickness.



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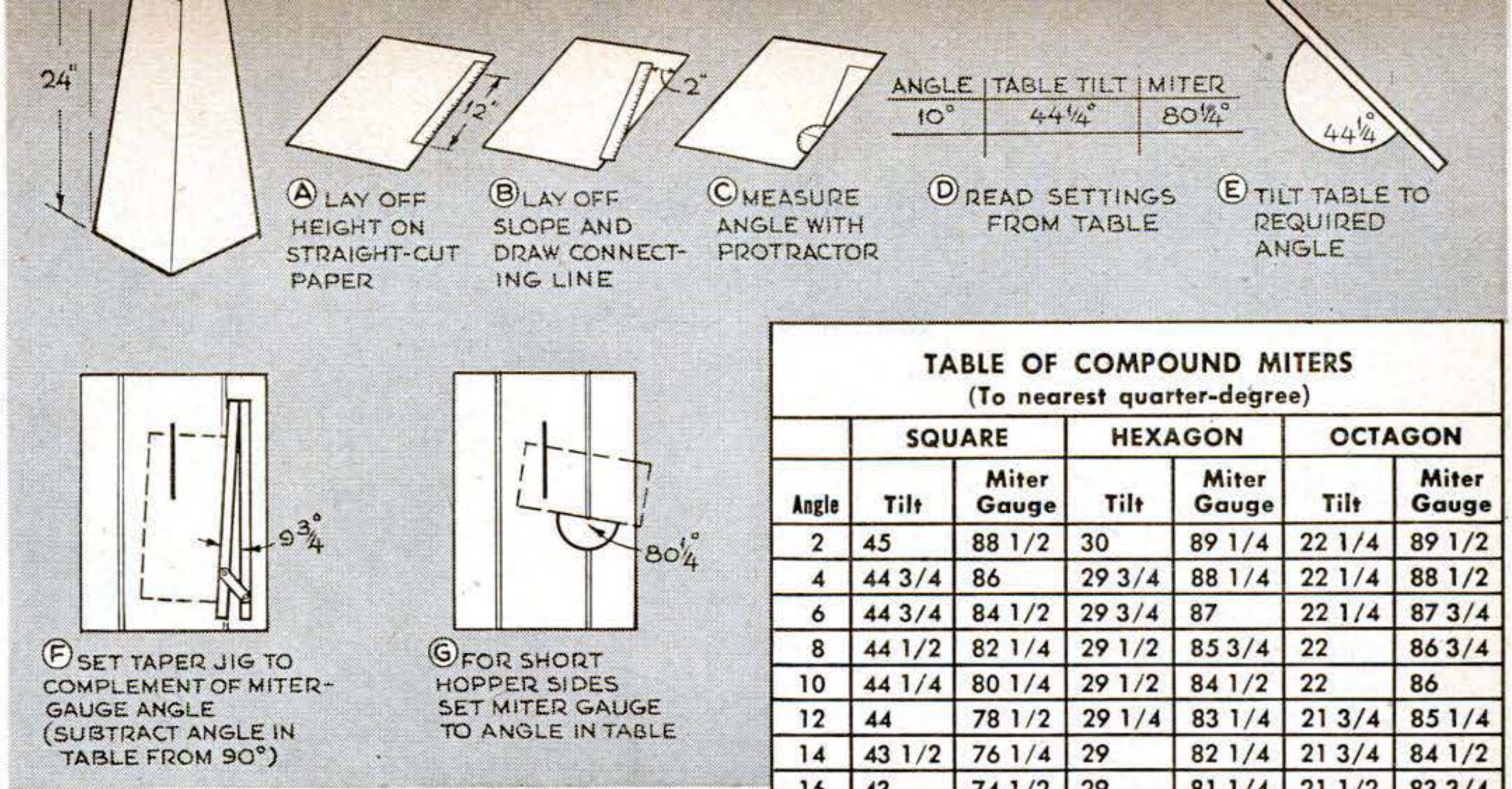

ANGLE	TABLE TILT	MITER
10°	44¼°	80¼°

14. Given the dimensions shown at upper left, saw and miter settings can be arrived at by these steps. Readings are taken from table.

measure the angle with a protractor. In this case it comes to about 10°.

Refer to Table 15, which shows that the saw table must be tilted to 44¼° (Step E). This assumes that the tilt scale is at 90° when level. The table also gives the miter-gauge setting for the same cut, but on a long column it may prove difficult to use the miter gauge. This is where the adjustable taper jig of Fig. 2 comes in handy again. It can be set to bear against the long edge. Since it slides against a fence at 90° to the normal miter position, set it to the *complement* of the gauge angle (Step F). Fig. 3 shows a compound miter being cut with the aid of the jig. For short hopper sides you can use the miter gauge, setting it directly from the table (Step G).

There's another method that may be simpler. Forget all about the table and proceed to lay out the work as you would if you were going to saw the stock by hand. Procedures were given in detail last month (PS, Aug. '49, p. 192) and are summarized in Fig. 16.

Step A (Fig. 16) shows how to measure and mark the length and end angle with a framing square. Square the end-bevel line across the face of the work (Step B). Slope of the sides is marked off as in Step C.

Set a bevel square against the angle determined in A, and tilt the saw table or arbor to a corresponding angle. You can then saw the top and bottom bevels, as in C1, by guiding against the rip fence. If the bevel is on the end of a column side, use a miter gauge in the square position. Since the beveled

TABLE OF COMPOUND MITERS
(To nearest quarter-degree)

	SQUARE		HEXAGON		OCTAGON	
Angle	Tilt	Miter Gauge	Tilt	Miter Gauge	Tilt	Miter Gauge
2	45	88 1/2	30	89 1/4	22 1/4	89 1/2
4	44 3/4	86	29 3/4	88 1/4	22 1/4	88 1/2
6	44 3/4	84 1/2	29 3/4	87	22 1/4	87 3/4
8	44 1/2	82 1/4	29 1/2	85 3/4	22	86 3/4
10	44 1/4	80 1/4	29 1/2	84 1/2	22	86
12	44	78 1/2	29 1/4	83 1/4	21 3/4	85 1/4
14	43 1/2	76 1/4	29	82 1/4	21 3/4	84 1/2
16	43	74 1/2	29	81 1/4	21 1/2	83 3/4
18	42 1/2	72 3/4	28 1/2	80 1/4	21 1/4	82 3/4
20	41 3/4	71 1/4	28 1/4	79	21	82 1/4
22	41 1/4	69 1/2	27 3/4	78	20 3/4	81 1/2
24	40 1/4	67 3/4	27 1/2	77	20 1/2	80 3/4
26	39 1/4	66	27	76	20 1/4	79 3/4
28	38 1/2	64 3/4	26 1/2	75	19 3/4	79 1/4
30	37 3/4	63 1/2	25 3/4	74	19 1/2	78 1/2
32	36 3/4	62	25	73	19	77 3/4
34	35 3/4	60 1/2	24 3/4	72	18 1/2	77 1/4
36	34 1/2	59 3/4	23 3/4	71 1/2	18	76 1/2
38	33 1/2	58 3/4	23	71	17 1/2	75 3/4
40	32 1/2	57 1/2	22 1/4	69 1/4	17	75
42	31 1/2	56 1/2	21 1/4	69	16 1/2	74 1/2
44	30 1/2	55 1/4	20 3/4	68 1/2	16	74
46	29 1/4	54 1/4	20 1/4	67 3/4	15 1/2	73 1/4
48	28 1/4	53 1/2	19 1/2	67	14 3/4	72 3/4
50	27 1/4	52 1/2	19	66 1/4	14 1/4	72 1/4
52	25 3/4	51 3/4	18	65 1/2	13 1/2	72
54	24 1/2	51	17	65	13	71 1/2
56	23 1/2	50 1/4	16	64 1/2	12 1/4	71
58	22 1/4	49 3/4	15 1/4	64	11 3/4	70 1/2
60	21	49 1/2	14	63 1/2	11	70 1/4

15. Knowing the angle of slope you can read saw and miter settings directly. Settings for intermediate angles can be estimated.

edges become horizontal when the staves are put together, the angle of the miter can be drawn directly on the bevel. In the case of a square, the angle is 45°; if it were hexagonal, it would be 60°. This angle can be marked on the beveled edge as in C2.

To cut a miter, adjust the miter gauge to correspond with one sloping line drawn on the face in C. Hold the work against the gauge head and sight along the blade of the saw at the miter marked on the top bevel. Tilt the table or arbor to bring blade into line with the miter. Take a light starting cut at the mark. If correction is needed, shift the tilt.

Once the table and gauge are set

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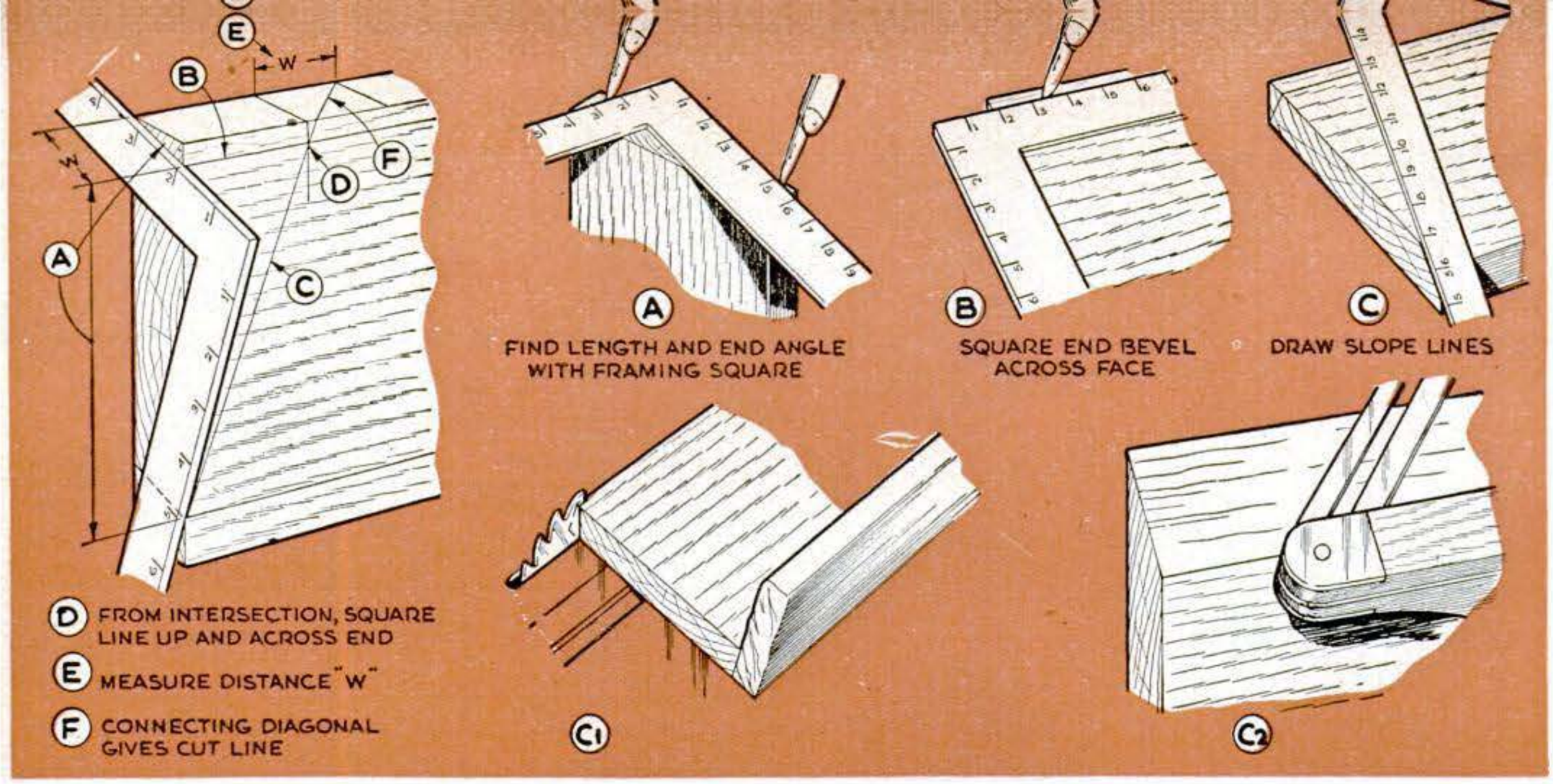
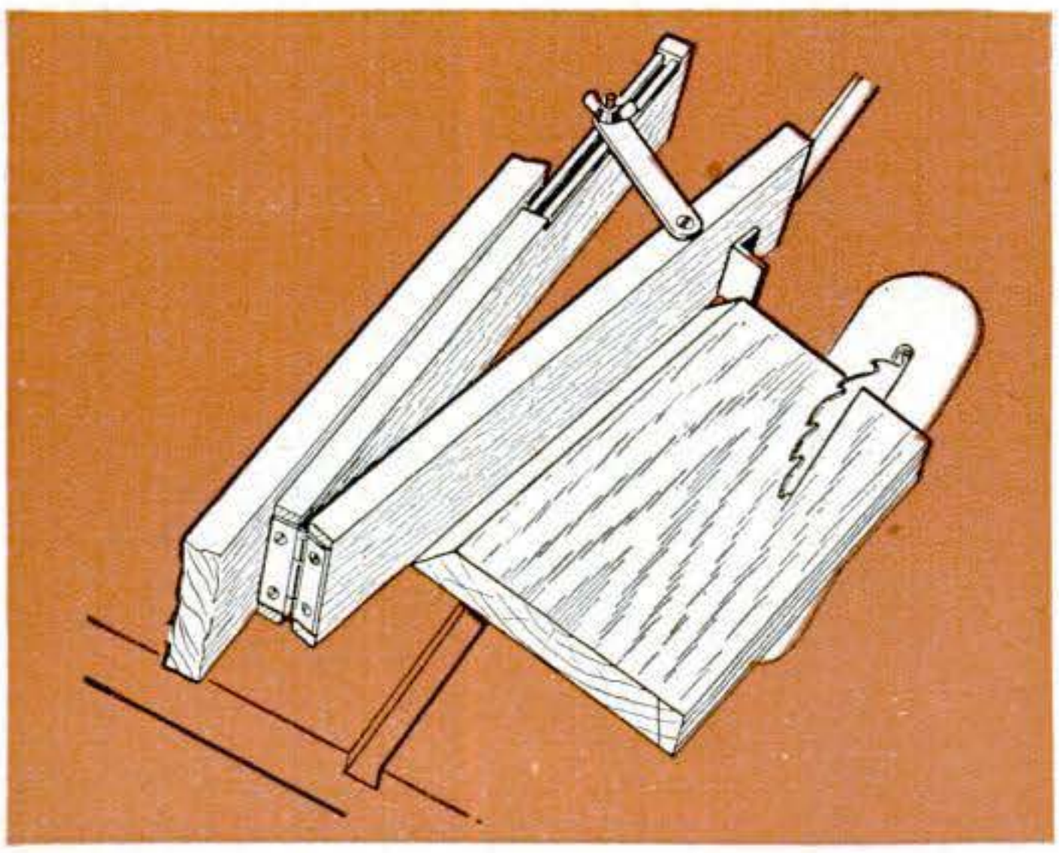


16. For visual saw setting, mark angle on edge of wood. Full details were given last month.



17. To cut the second miter, spread the taper jig to twice the first setting. Turn it and the work end for end. Set fence above the saw.

you can cut all corresponding pieces at the same setting. Read the degree setting of the gauge, swivel it to the same setting in the opposite direction, and cut the other sides.

If you want the top and bottom edges of the hopper side to remain square, the further steps shown in D and E (Fig. 16) are taken to obtain the miter angle on a square end.

Procedure for a tapered column miter follows that for a hopper side except that the tapering jig is used. It is spread to correspond with the slope line drawn on the stock and the table is tilted by sighting along the angle drawn on the end. To cut the other side, spread the jig to twice the angle. Turn both jig and board end for end (Fig. 17). END

FINDING ANGLES WITH A FRAMING SQUARE [WOODWORKING]

Knowing an angle and being able to copy that angle in wood are two different things. Most protractors are too small to permit angles to be copied off reliably, and a good protractor head may not always be available. A framing square, however, will usually serve the purpose nicely. The following table shows how to use one for obtaining degree settings. In all cases the reading on the blade is 12″. If an angle of, say, 32° is wanted, lay a straightedge from 12″ on the blade to 7½″ on the tongue. The smaller angle formed by one arm and the straightedge is the desired one. To obtain an angle of 58° (the complement of 32°) use the same setting but read the larger angle. Once the angle is found on the framing square a taper jig or bevel square can be set to fit.

The table can also be used in reverse, as when the lean of a hopper side is given in inches. If the slope is known to be, for example, 2½″ in 12″, the angle is just slightly under 12°. Intermediate values can be estimated fairly closely.

TABLE OF DEGREES FOUND BY MEASUREMENTS ON FRAMING SQUARE

(Read 12″ on blade of square in all cases)

Degrees	Tongue Reading	Degrees	Tongue Reading	Degrees	Tongue Reading	Degrees	Tongue Reading
2	7/16+	14	2 31/32–	26	5 7/8	38	9 3/8
4	25/32+	16	3 7/12–	28	6 3/8	40	10 1/16+
6	1 9/32–	18	3 15/16–	30	6 15/16–	42	10 13/16–
8	1 11/16–	20	4 7/16	32	7 1/2	44	11 7/12
10	2 3/16+	22	4 3/4	34	8 3/32+	45	12
12	2 9/16	24	5 11/32	36	8 23/32+		

POPULAR SCIENCE MONTHLY SHOP DATA

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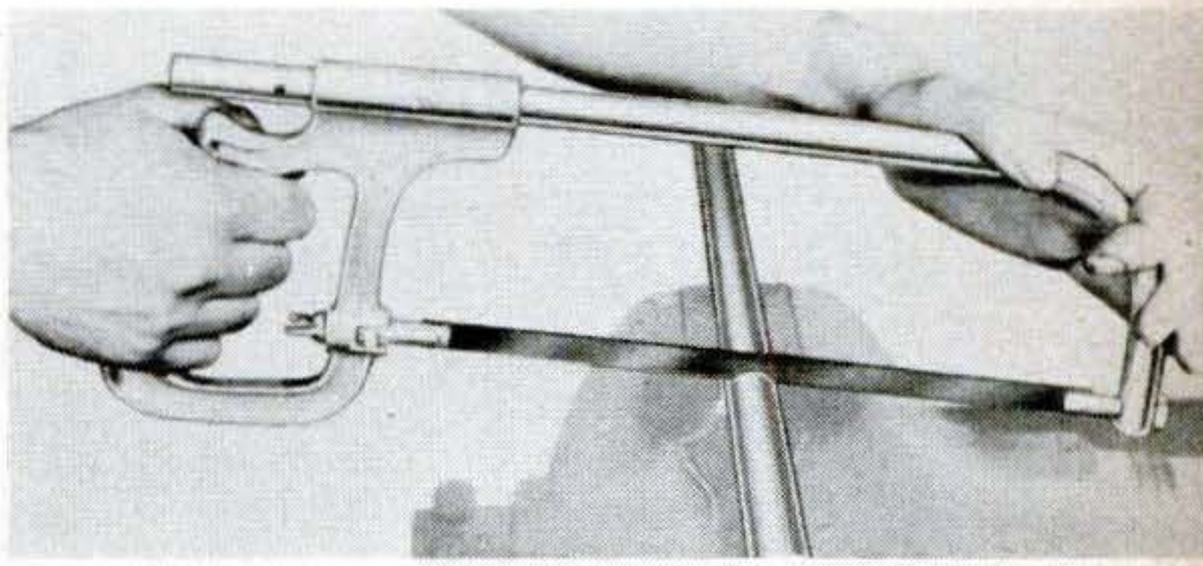
NEW TOOLS

Mortise Cut with Drill. Here is an adapter that brings your mortising chisel and electric drill together to form a mortising tool that's portable. Adapter and chisel can be fitted to a drill of any size in a matter of seconds. The adapter can also be used on a drill press.

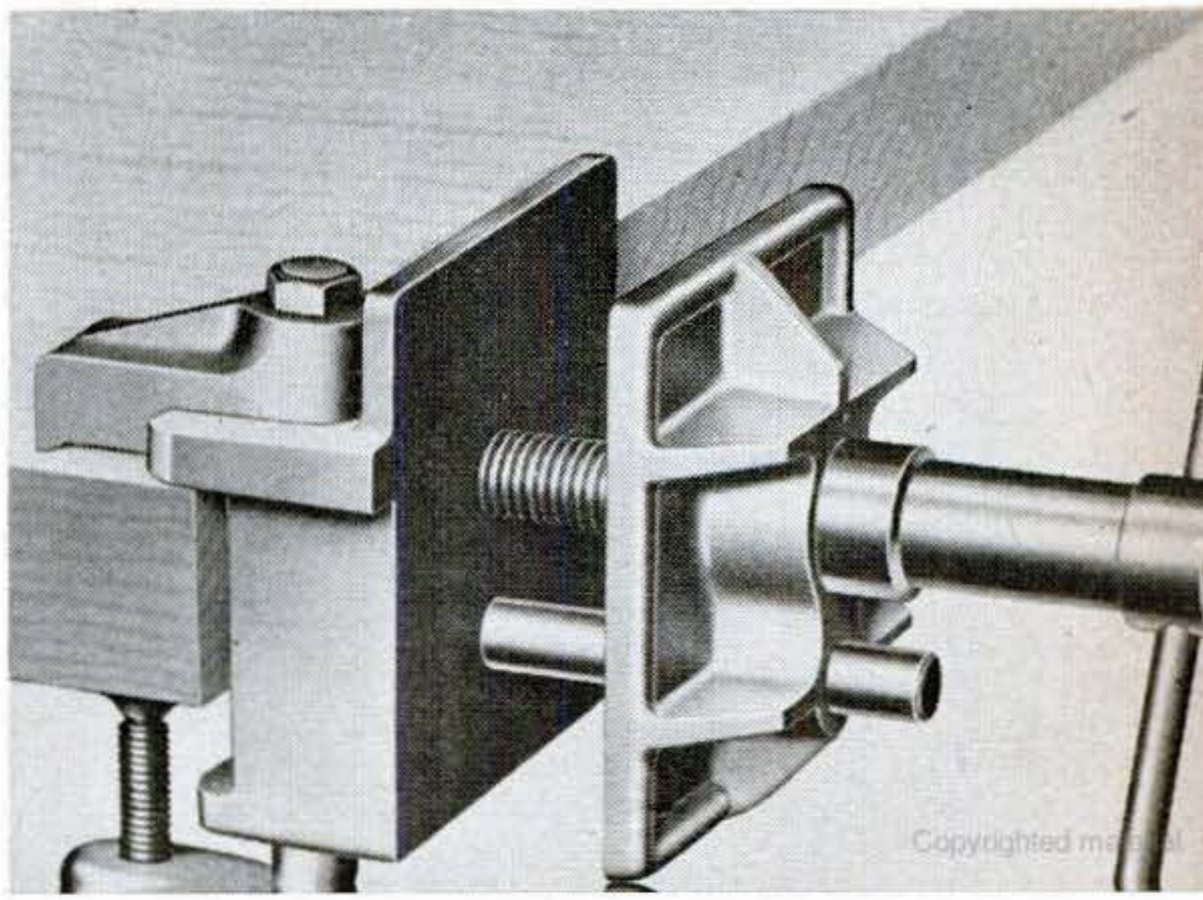
The Bertram Manufacturing Company, of Kansas City makes the adapter, which retails for approximately $7.

Saw Frame Resists Twist. The frame back of this hacksaw consists of a single piece of steel tubing. The rigidity of the tubing is said to permit tightening the blade to high tension without twisting the blade or warping the frame. A cast-aluminum handle is adjustable for 10″ and 12″ blades. Machine Rebuilding Company, of Detroit, makes the saw. It sells for about $4.



Disks Reseat Valves. Valve and faucet reseating equipment marketed by Grace Products Co., Birmingham, Ala., uses aluminum oxide disks on a steel backing plate as the grinding material. Each unit has a coarse abrasive on one side, fine on the other. A brace or hand drill equipped with a screwdriver bit turns the disks. These can be replaced when worn. A boxed set to reseat ½″ to 2″ valves costs about $19.

Carry Your Vise Along. As its name suggests, the 3½-lb. Porto-Vise® below is designed for carrying to the job. The jaws are 4″ square, open to 2½″, and a steel guide keeps them aligned as the main screw turns in and out of the drilled handle. Work can be placed anywhere in the aluminum-alloy jaws—top, sides, or bottom. The mounting clamp opens to 2½″. Parent Brothers, of Los Angeles, makes the vise.



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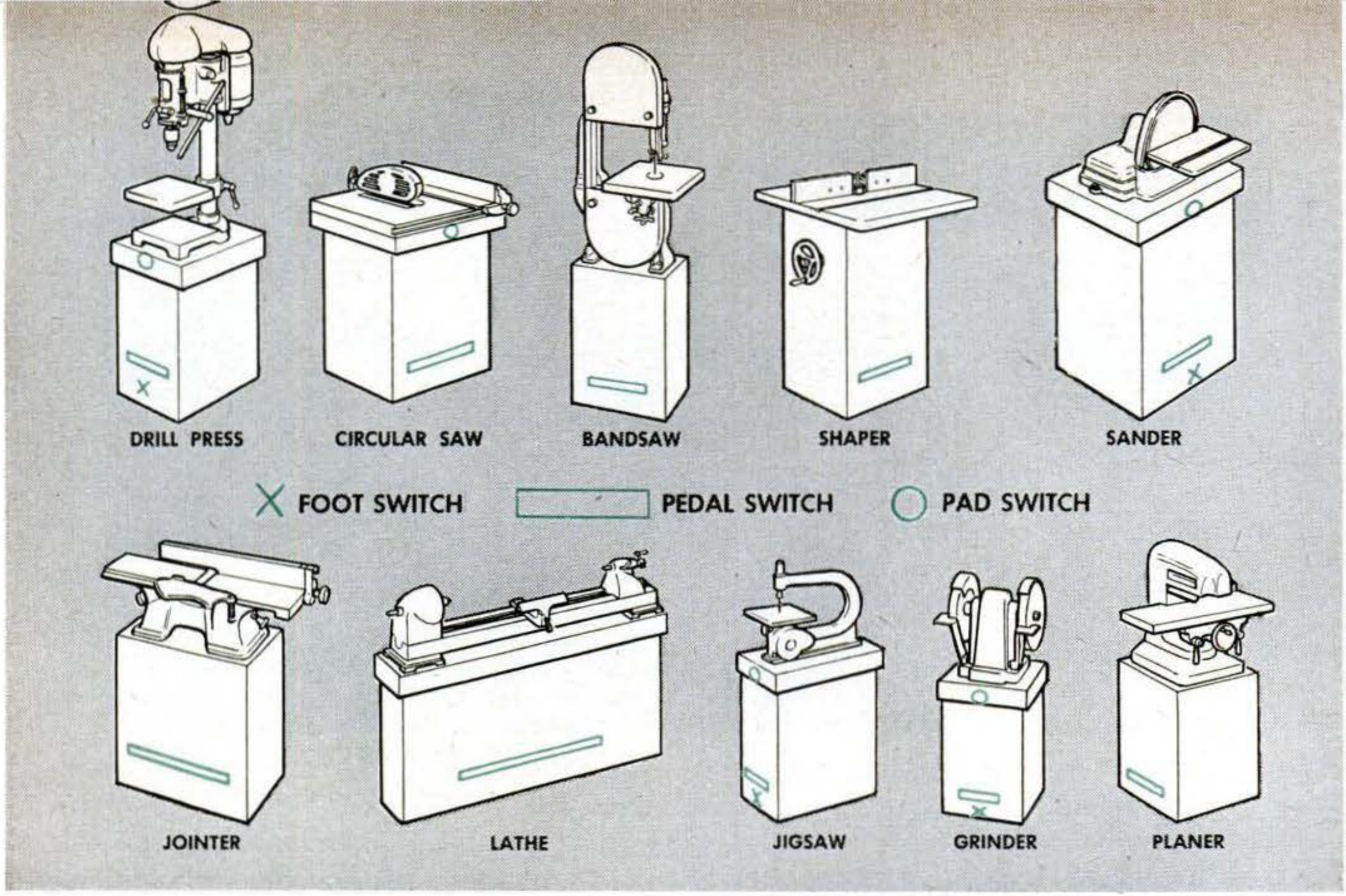
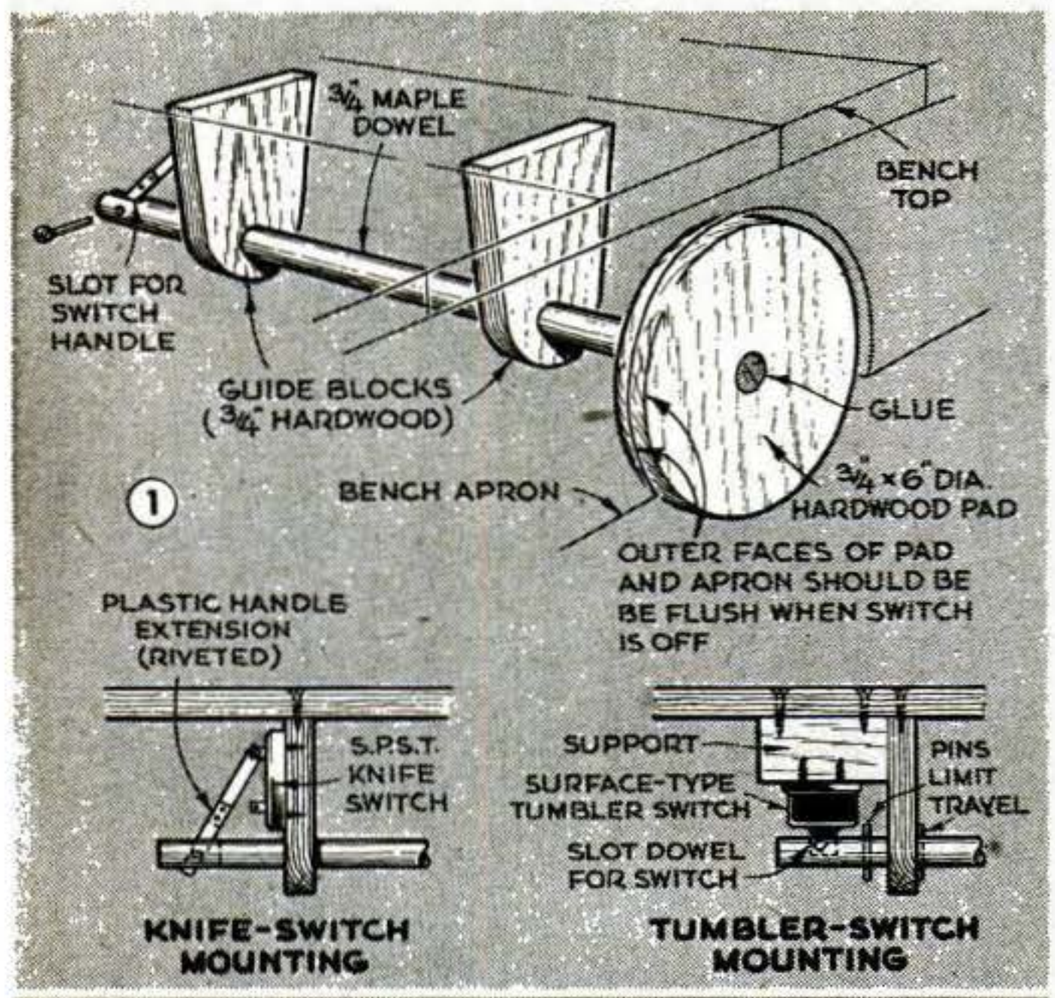


Let your own working methods determine switch type and position. Here are common ones.

Security Switches Make Power Tools Safer

By Will Thomas

Pad switch is best installed on machine having a wooden face or apron. Set the pad flush with the apron so it won't be pulled accidentally.



IF YOU operate small workshop machines, you must have seen how accidents begin. Maybe a drill jams, a clamp works loose, or a holder was improperly tightened. You see the accident begin, and you see it happen, but you can't prevent it. With both hands busy, you can't reach the motor switch.

Security switches installed on shop machines enable you to turn off the power instantly without using your hands. They often prevent injury as well as damage to tools and materials. They also make your tools more efficient and easier to operate.

Security switches are actuated by foot or body. They are easy to construct and install once their principles are understood. When planning an installation, remember these five points: 1, security switches are useful chiefly on machines where the work is hand fed; 2, they should be made convenient for regular machine operation so that their use will be automatic in emergencies; 3, they must be placed where you can reach them from any normal working position; 4, they should be built or placed so that they can't be turned on accidentally; 5, don't overesti-

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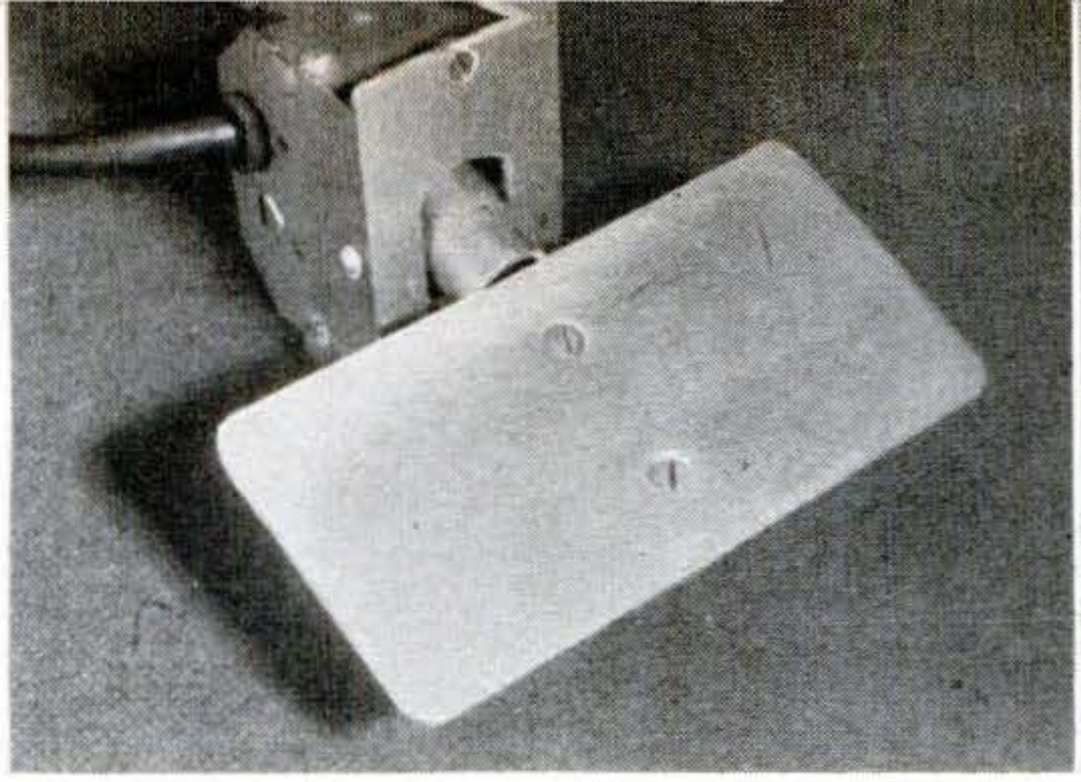
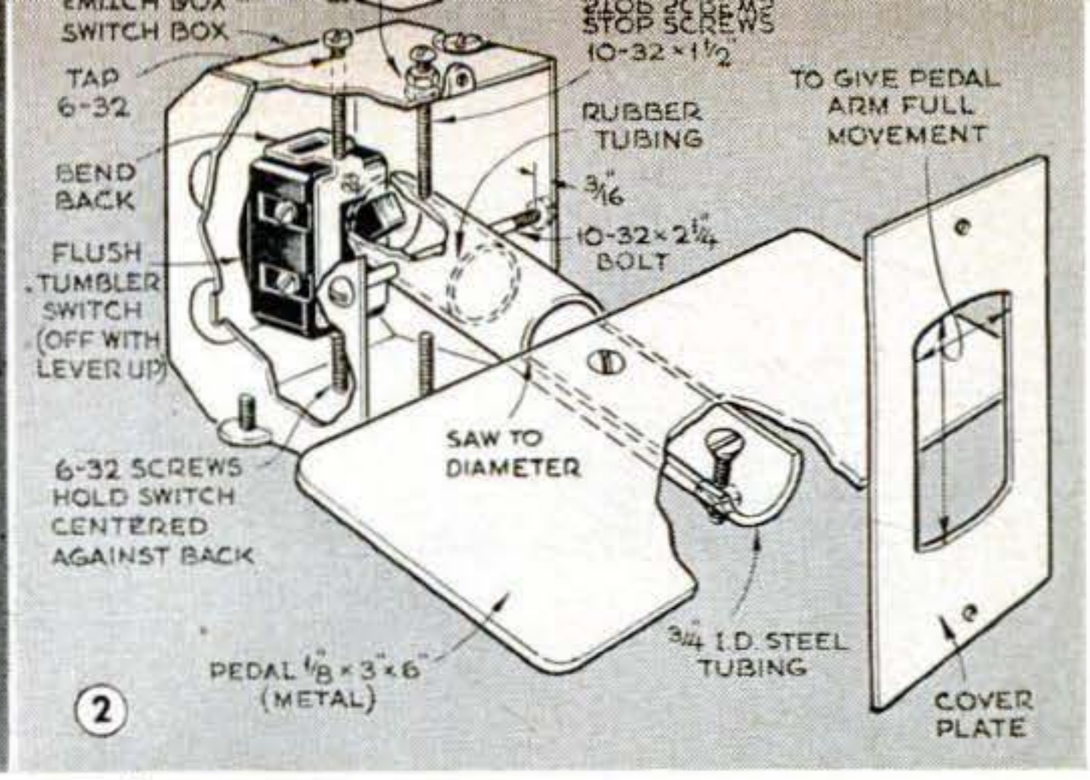




Heavy-duty pedal switch can be attached to the bench by metal straps or it may be bolted on through holes in the box. Place the pedal 6" to 1' above the floor and about 1' back from the apron. Set back, it won't be accidentally kicked up while you're making adjustments.

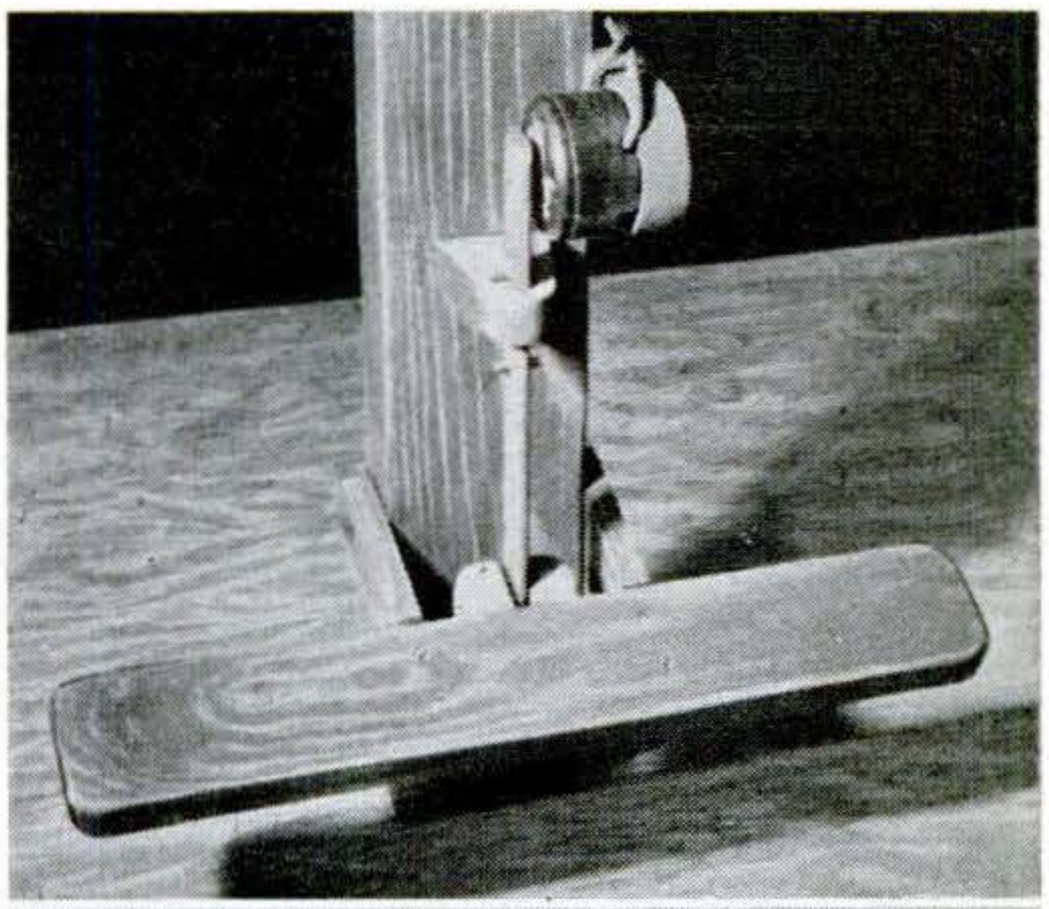
mate their value. They are not substitutes for proper guards or correct working methods. They will not prevent sudden, split-second accidents.

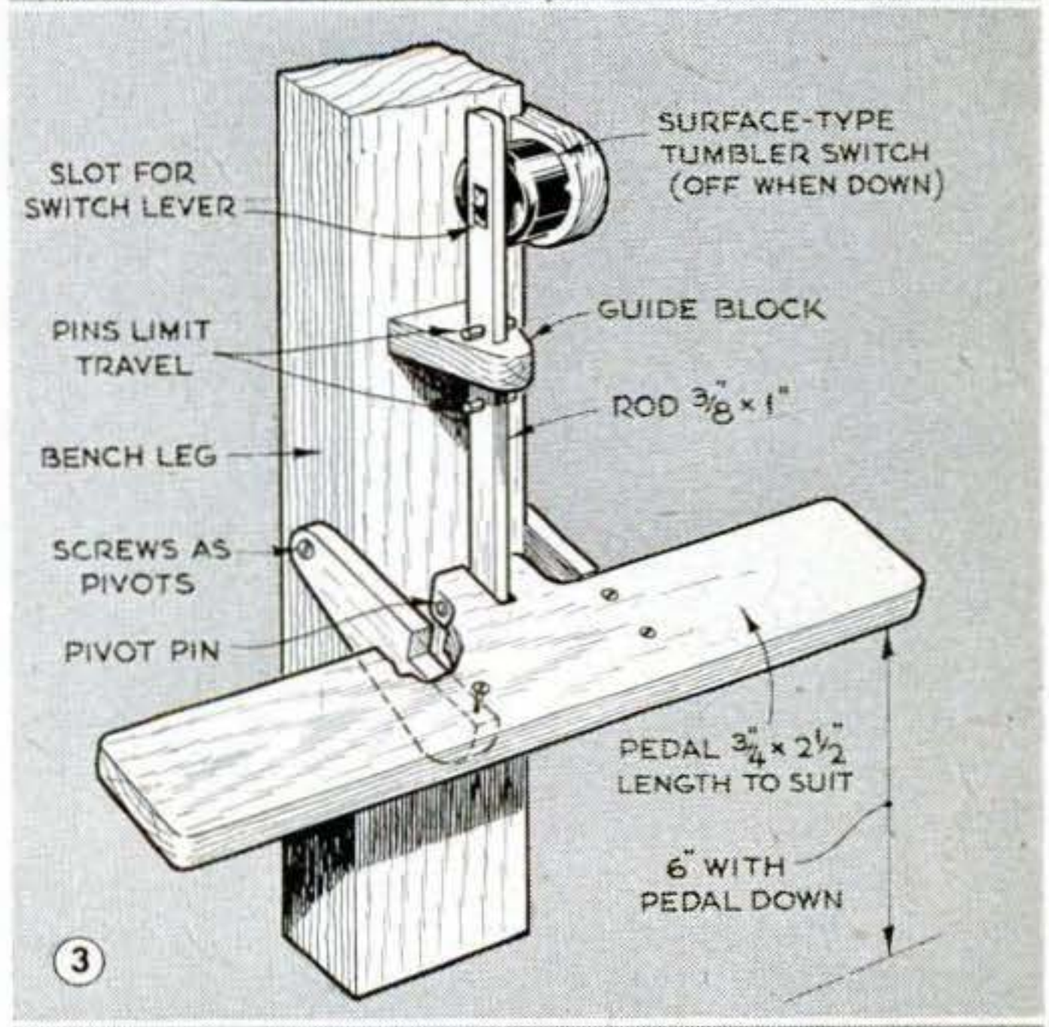
Pad-actuated switches are turned off by body pressure, so they must be placed hip or waist high. They're good only on machines that do not require you to move your body out of range during normal use. This type of switch goes best on a machine having a wooden face or apron into which the pad can be set. If the pad is flush with the apron, it won't be pulled on accidentally while you are setting up the work. It will also be protected against damage if you happen to strike it too violently in an emergency. Allow a small portion of the pad to extend below the apron, or provide a finger hole with which to turn it on. Figure 1 shows the application to both knife and tumbler switches.

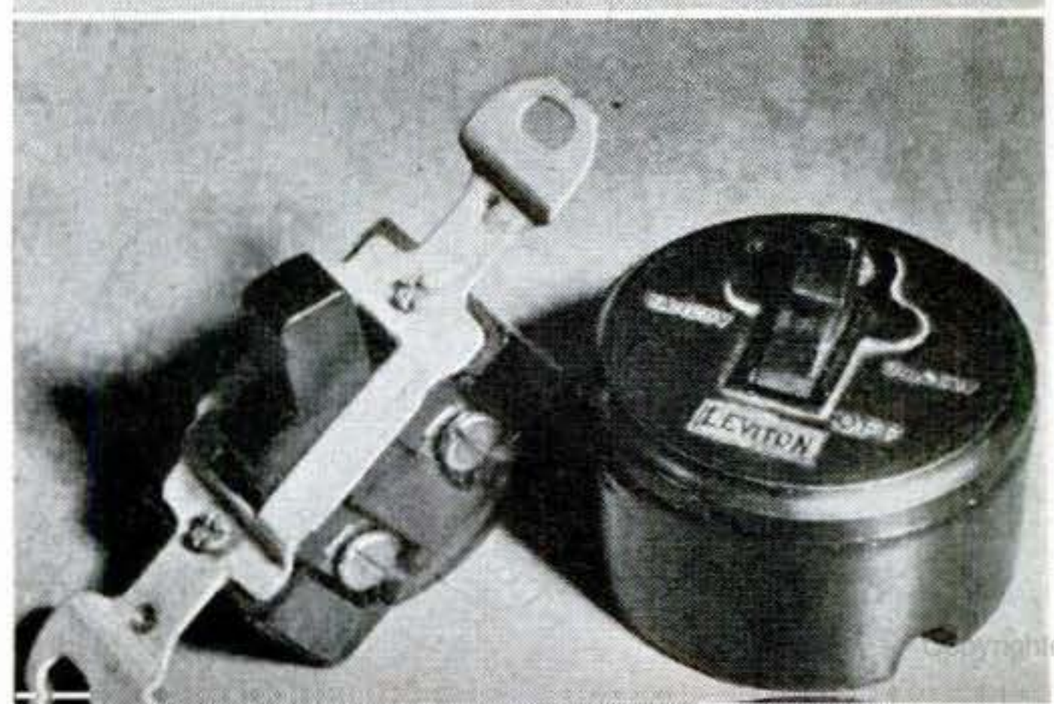
Pedal-actuated security switches have the greatest range of application because pedals can be made long enough to be accessible from almost any position. Essentially this type of switch consists of a pedal held to a bench leg or frame by pivoting arms. Two typical setups are shown in Figs. 2 and 3. The heavy-duty switch of Fig. 2 is made of inexpensive metal parts; for less demanding use, the unit pictured in Fig. 3 is recommended by its ease of construction and small cost. If the rod must be made long, it is advisable to use a second guide block above the switch.

Spring-action foot switches of the normally-off type are used primarily for production work, but they also make fine security switches. You'll want this kind on machines where the power must be turned on and off frequently and where you are required to sit or stand in one position. This means that foot switches are ideal for jig-

Simpler pedal switch is easily made from a few pieces of wood and a tumbler switch (bottom). The pedal can be made almost any length.







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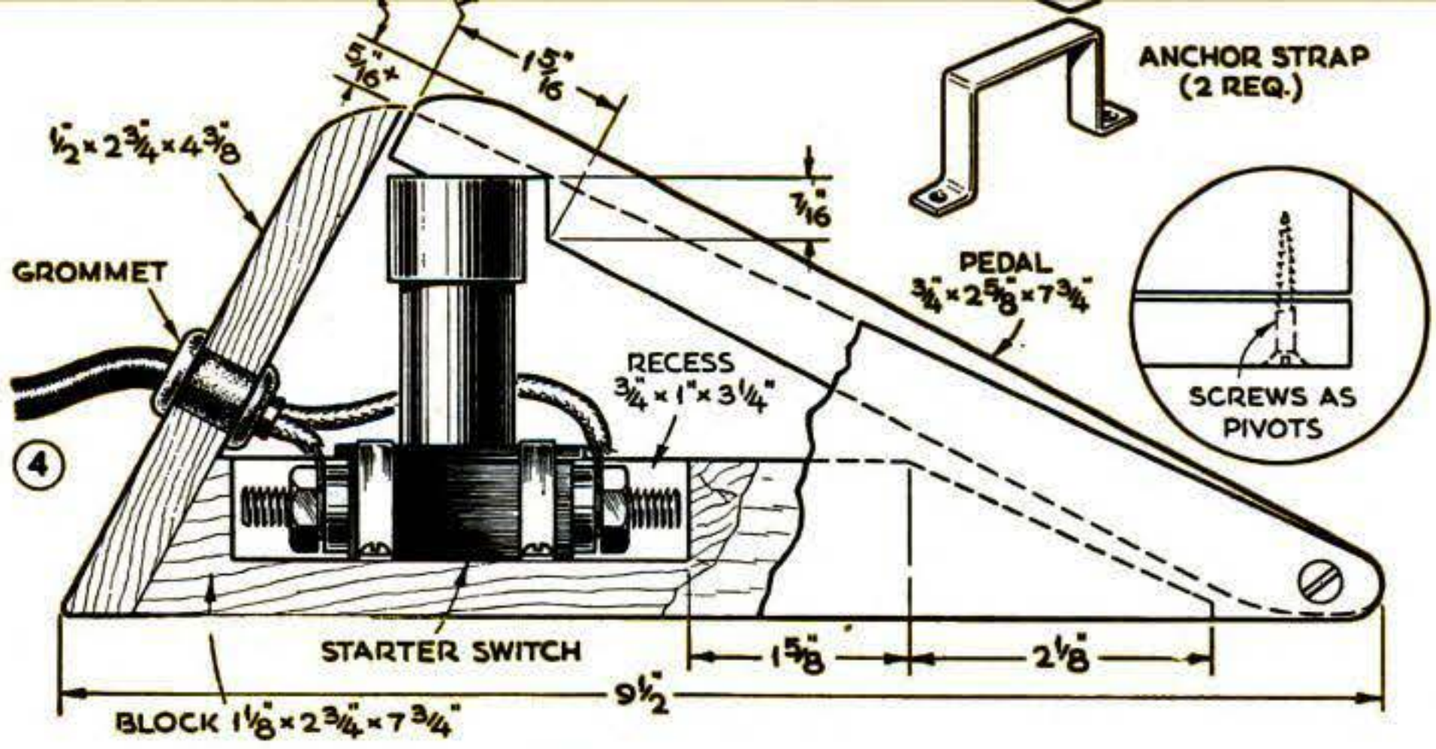
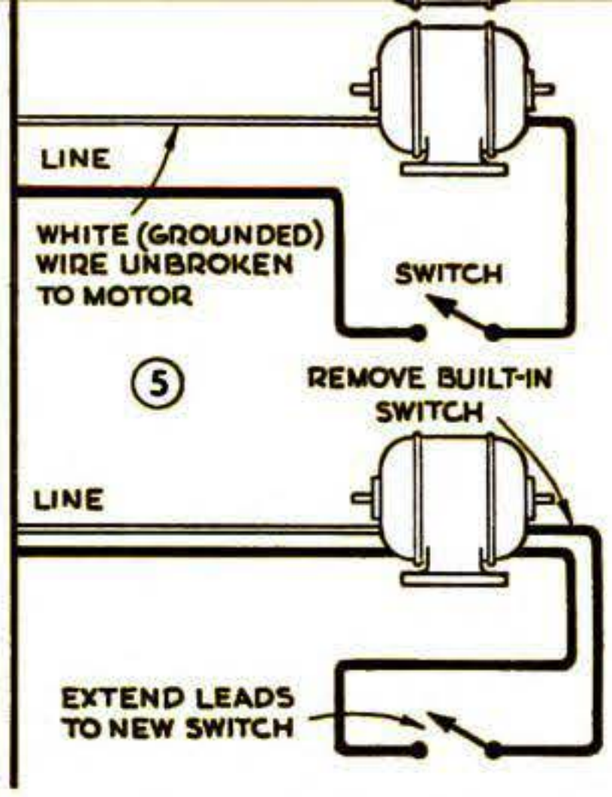




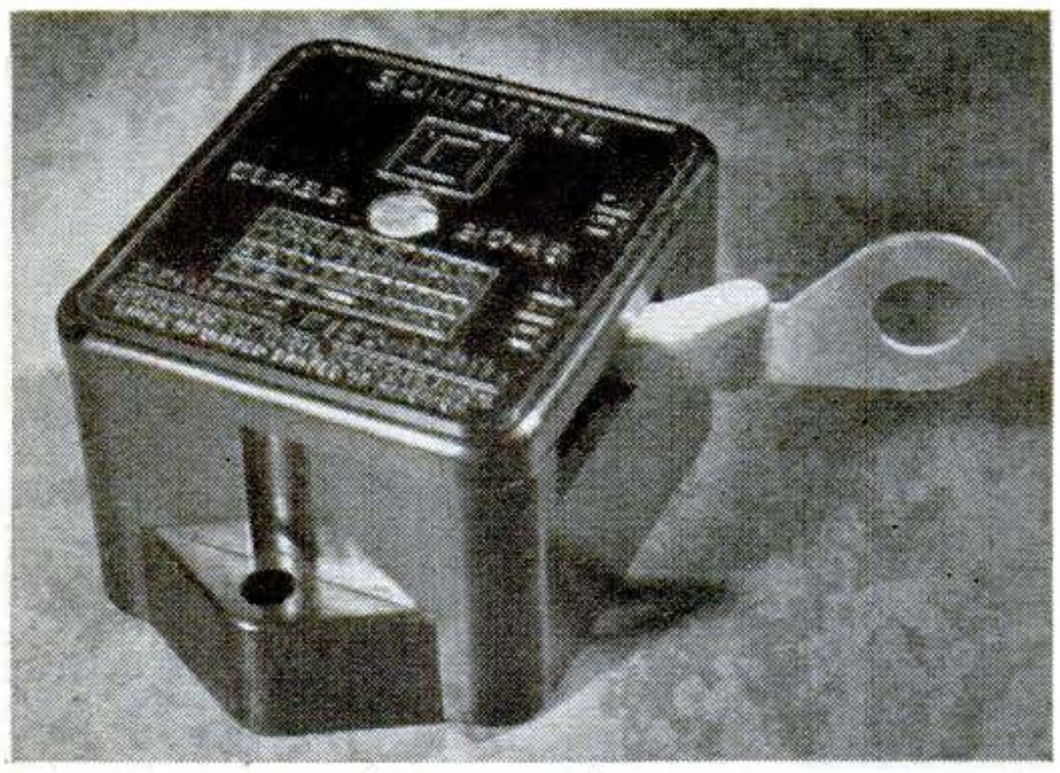
Foot switch shouldn't be attached to floor or machine. When wiring a switch (right) break the black, "hot" lead from power source to motor, not the grounded one. If machine has a built-in switch (lower right) it may be removed or wired in series with a security switch.

saws, grinders, drill presses, sanders, and the like.

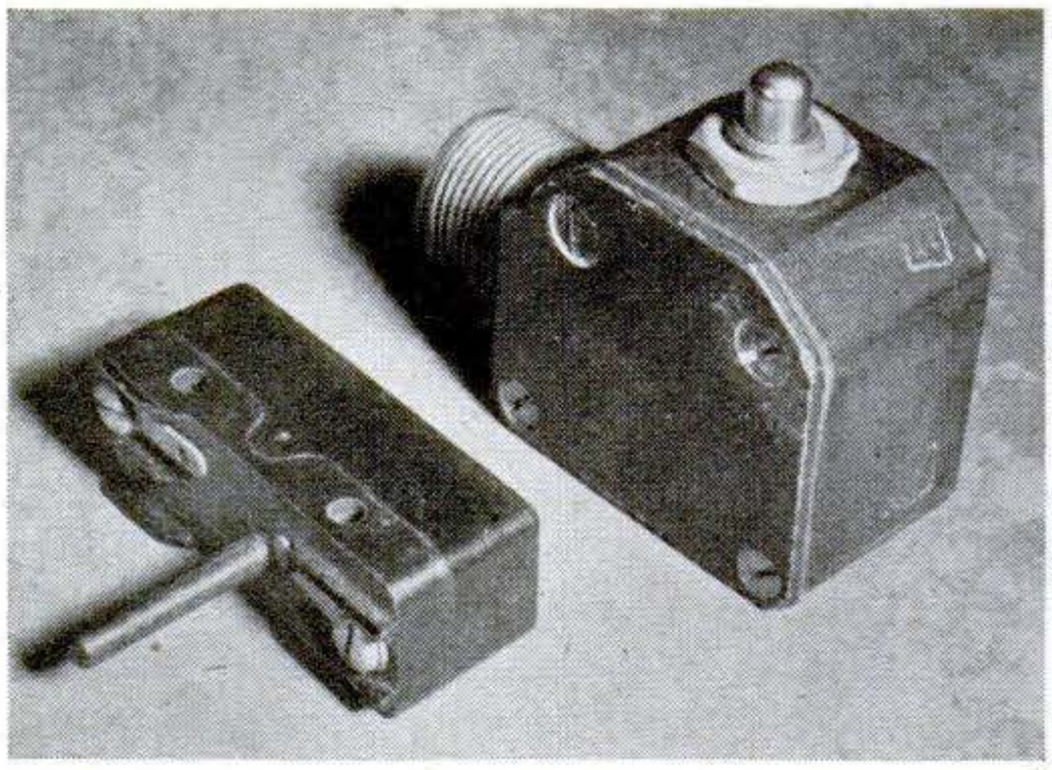
A good foot switch can be made from a starter switch picked up from an auto junk yard. Figure 4 shows how. Basically it's a box with a hinged top that serves as a turn-on pedal. The starter switch has its own spring, requires no limit-of-travel stops, and is very sturdy. A normally-off midget snap-action switch can be substituted.

It is important that the switch component be well constructed and have a current capacity at least equal to the amperage specified on the motor plate. Toggle-type float switches made for sump pumps are probably the best; tumbler switches are also good and less expensive. Knife switches are the least costly and are usually adequate. You may have to knock off the plastic handle and extend the knife by riveting to it a strip of some insulating material. Watch a knife switch for arcing. If it does arc, your best bet is to replace it with a switch of the toggle or float type.

It's extremely simple to wire in a switch. Just be sure to insert it in the black, ungrounded wire from the line to the motor (Fig. 5). If the motor is plugged into an outlet instead of being wired to a junction box, use a polarized plug. END

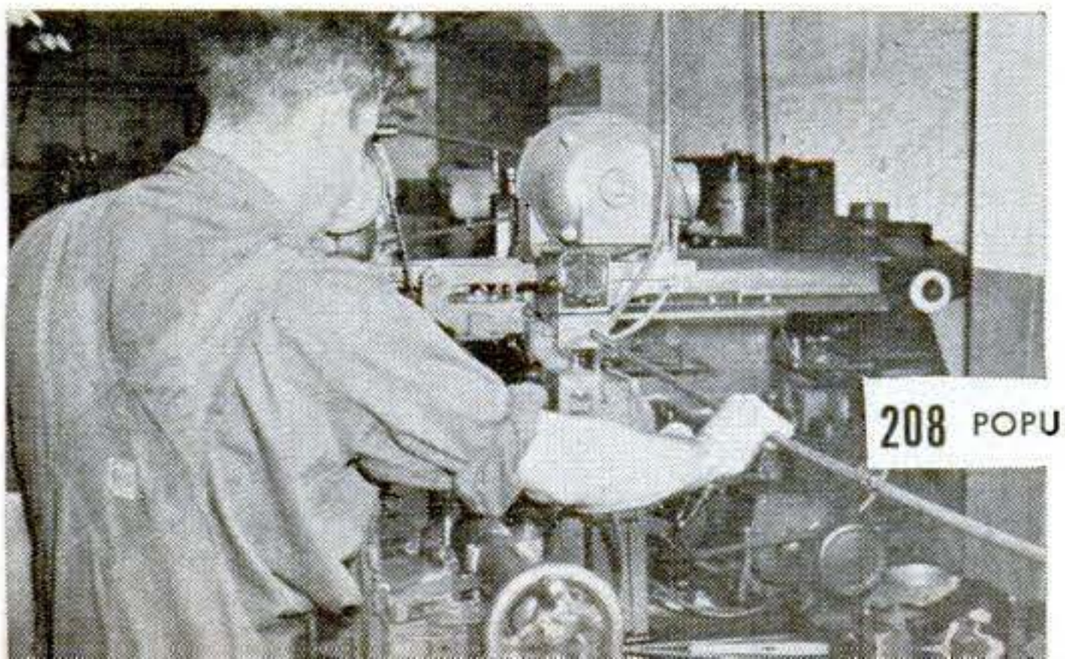


Float switch of the toggle type is expensive, but tops for use in pedal or pad switches. The metal lever simplifies installation.

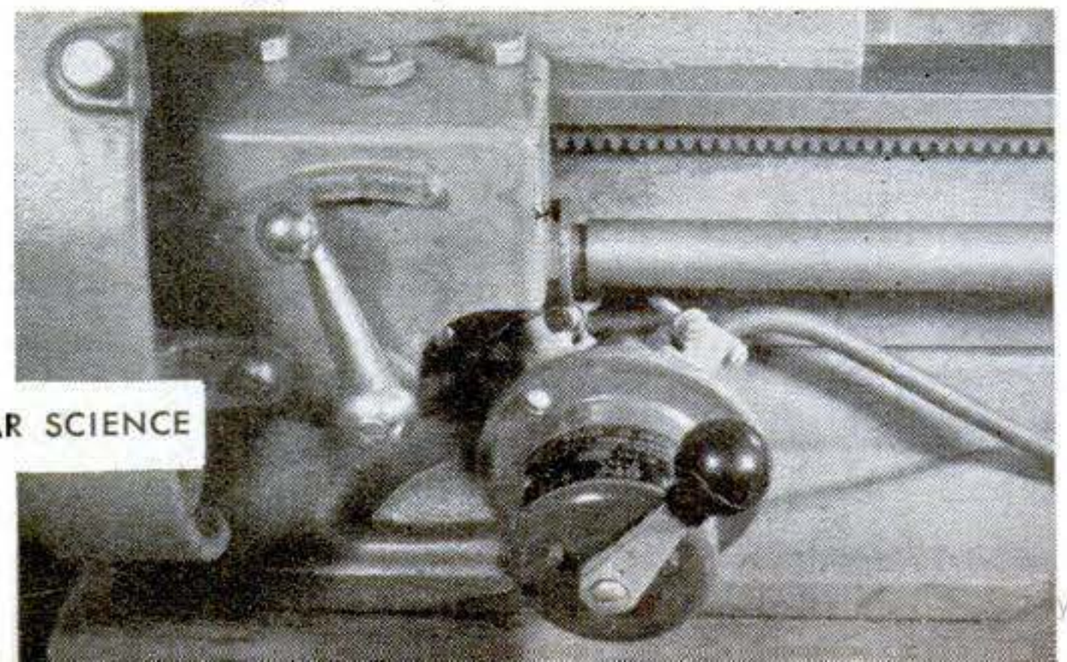


Midget snap switches come in many types and housings. They're good in foot switches, but stops and pedal-return springs must be added.

Motor-control rod permits the operator to stop a long lathe from any point. Rod runs in guides behind lathe to switch in back of headstock.



Reversing switch on metal-cutting lathe often makes security switch unnecessary. Metal lathe turns slowly, usually has automatic feed.



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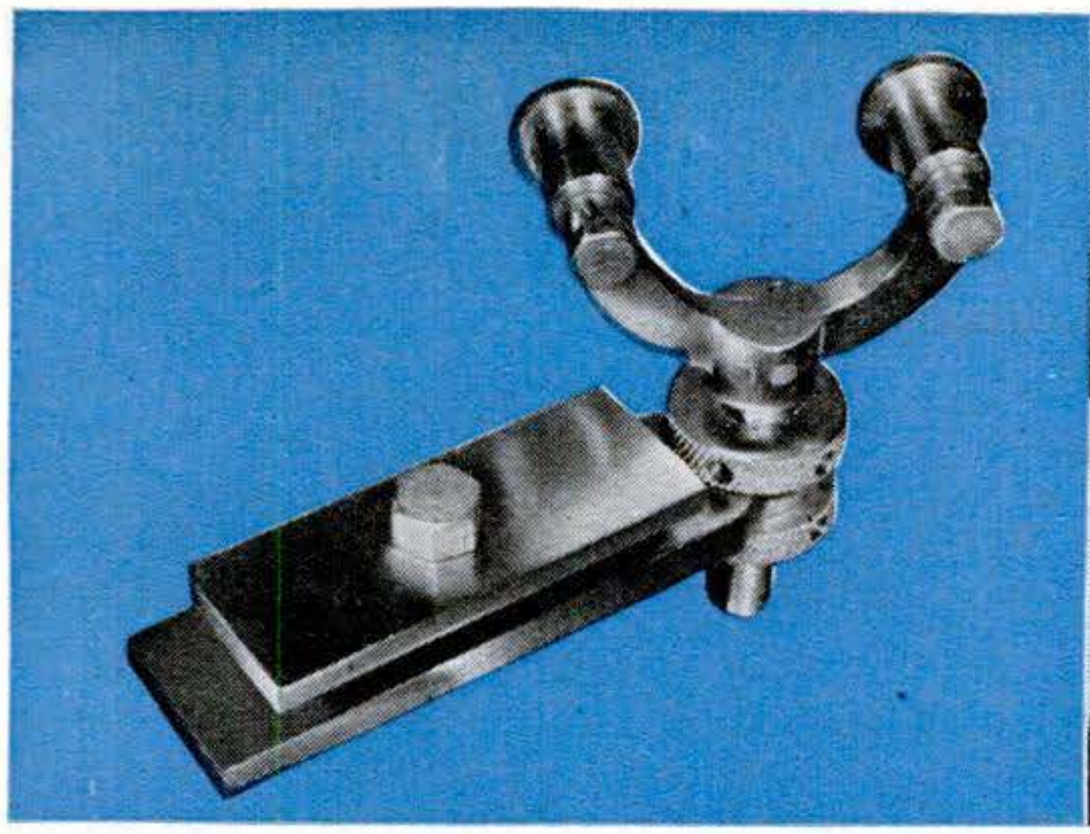
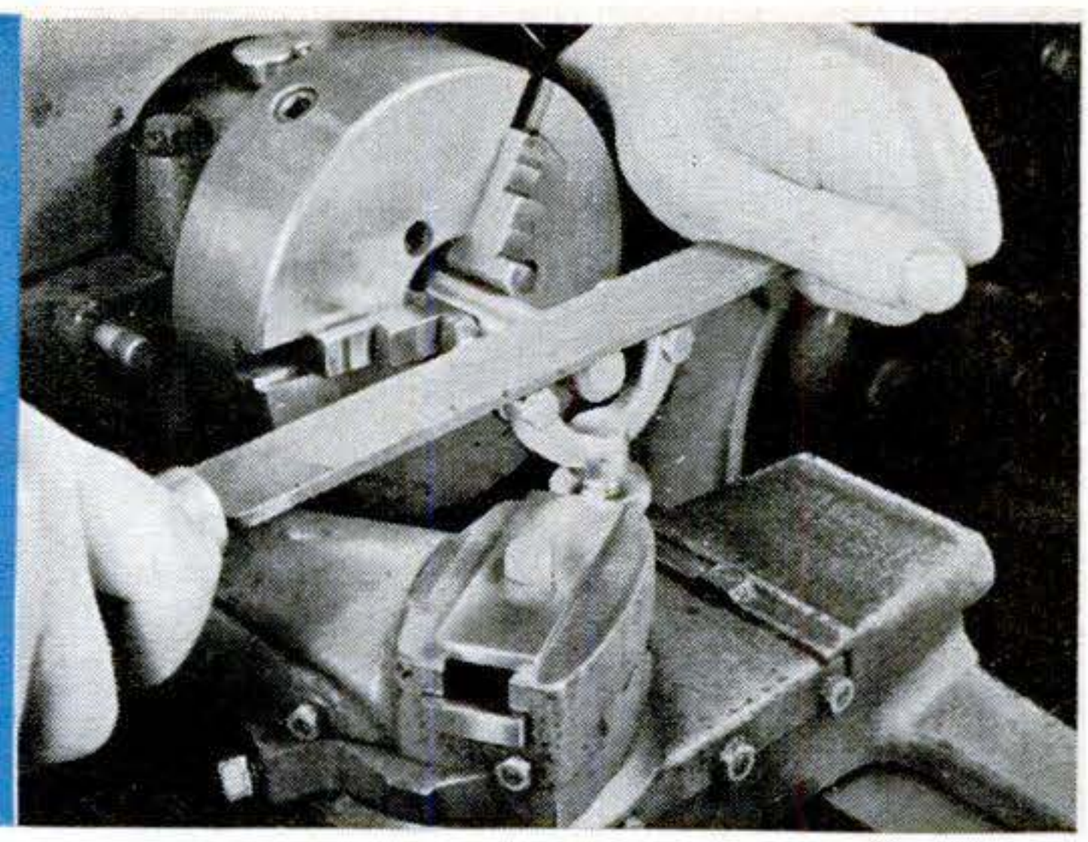




Finished all over, the filing rest is as handsome as it is handy. Used by machinists in the last century, it has had undeserved neglect in recent years. Above, end of work is squared up.

Filing Rest Does Small Milling Jobs

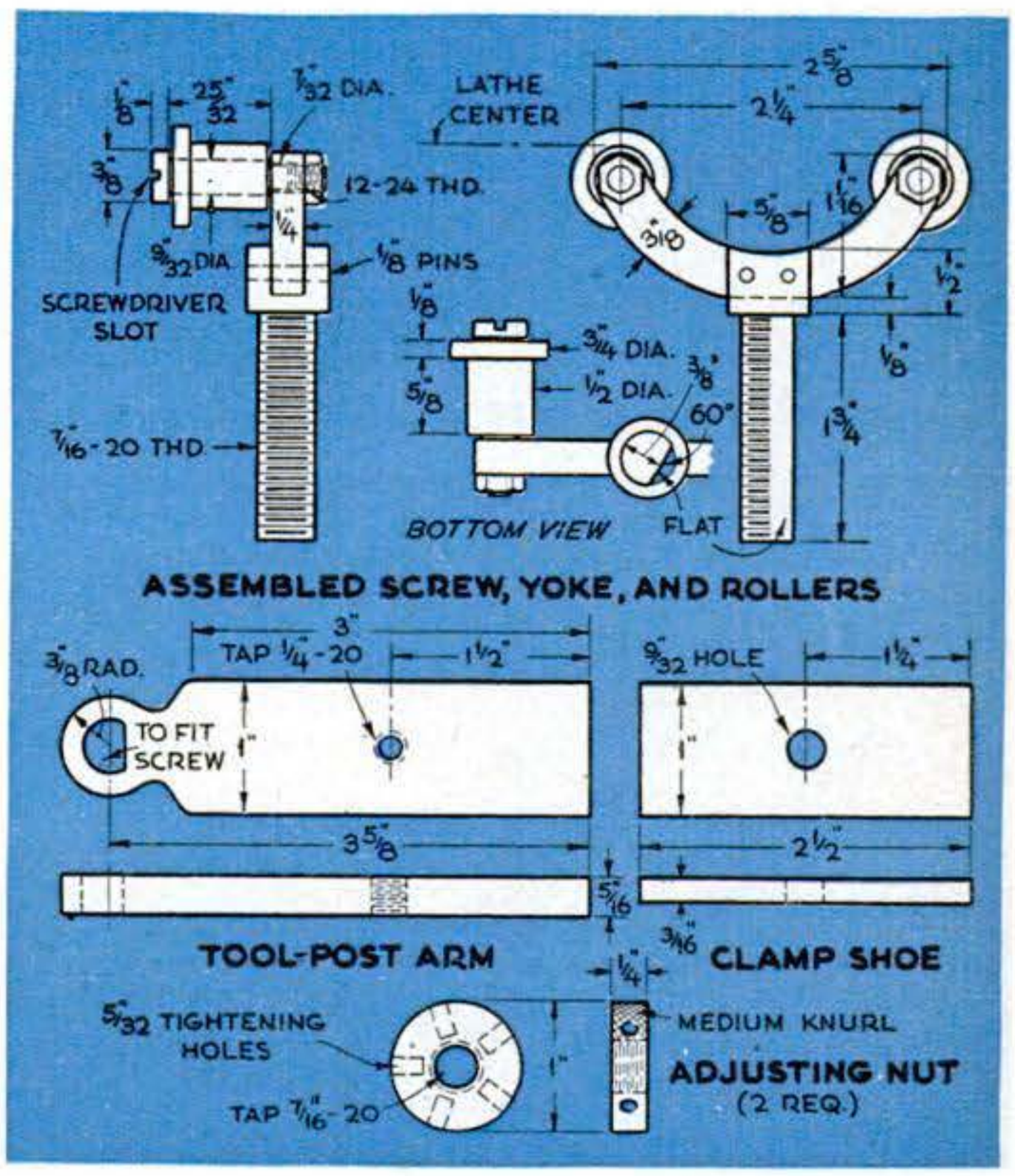
HERE'S an unusual but extremely useful lathe accessory. Set up in the compound rest in a matter of seconds, it helps you file accurate flats, squares, hexes, and other polygons on chucked work. During filing the work is locked by the indexing pin or the back gears. Even if your shop boasts a milling attachment or miller, chances are you'll prefer this rest for many jobs, since it's so quick and handy.

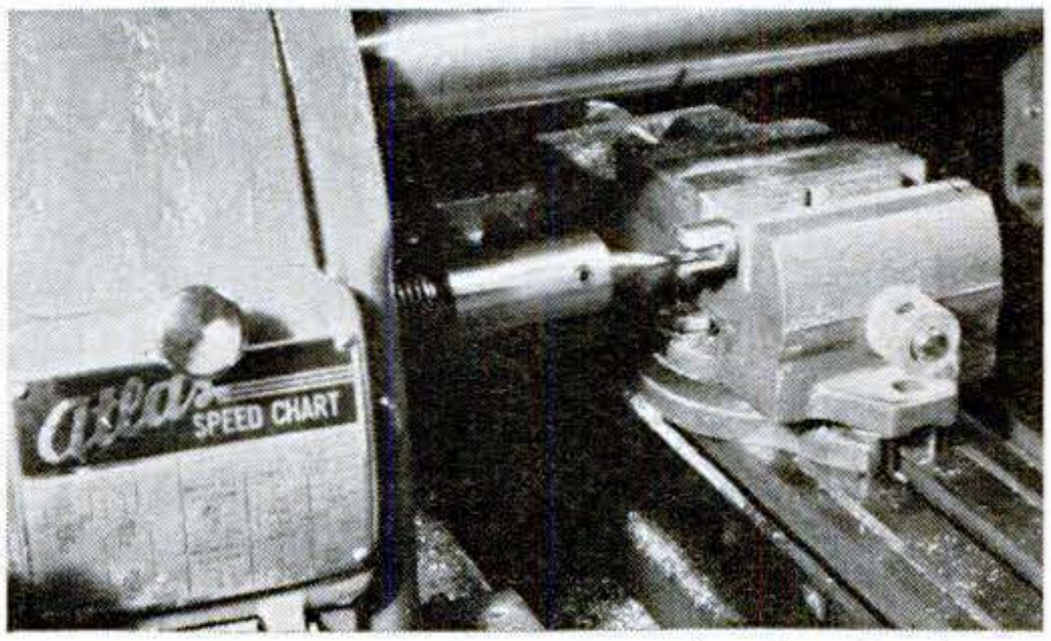
Dimensions given are for a popular 10″ workshop lathe. If yours differs, be sure that at the lowest point of adjustment, the working surface of the rollers is at lathe center height. The roller flanges should be 1½″ apart, and no part of the yoke nearer than ¾″ to the working center of the rest.

Note that the vertical screw has a flat on it, 60° away from the slot that takes the yoke. Passing through a special hole in the compound-rest arm, the screw and its yoke will then always be at right angles to the work when the compound is locked at 60°.

Start with the screw, machining it from ⅝″ stock. Mill or hacksaw the slot carefully, leaving it a bit undersize, thread the shank, and mill or file the flat 60° from the slot. Remove the burrs from the thread with a 7/16″-20 die, if you have one.

Lay out the yoke on ¼″ flat steel, drill the roller-pin holes, and saw it out roughly. (Drilling a series of holes just outside the line will save hacksawing sweat.) Force the yoke into the slot, drive in a couple of pins, and bring the yoke to finished shape. A grinding wheel or aluminum oxide disk will





Miller slots screw to accept yoke, but hacksaw and file will do. Paradoxically, a filing rest would be a very useful aid in making itself.

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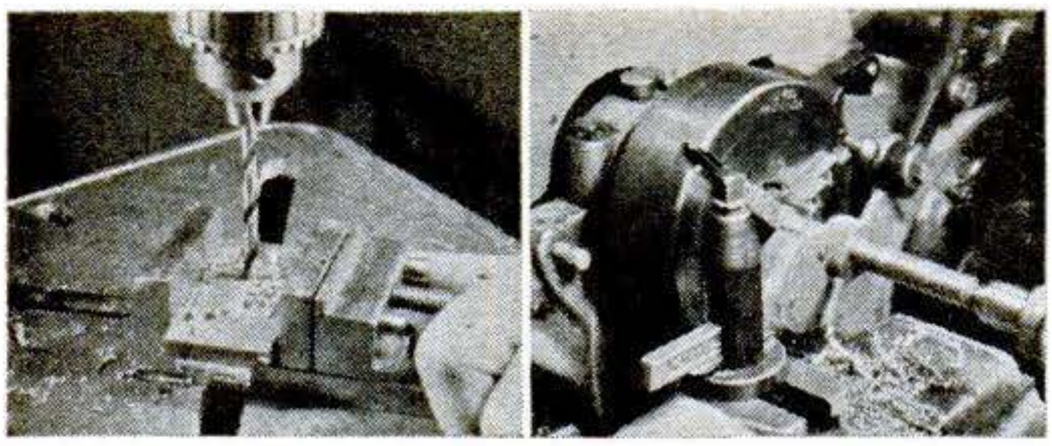
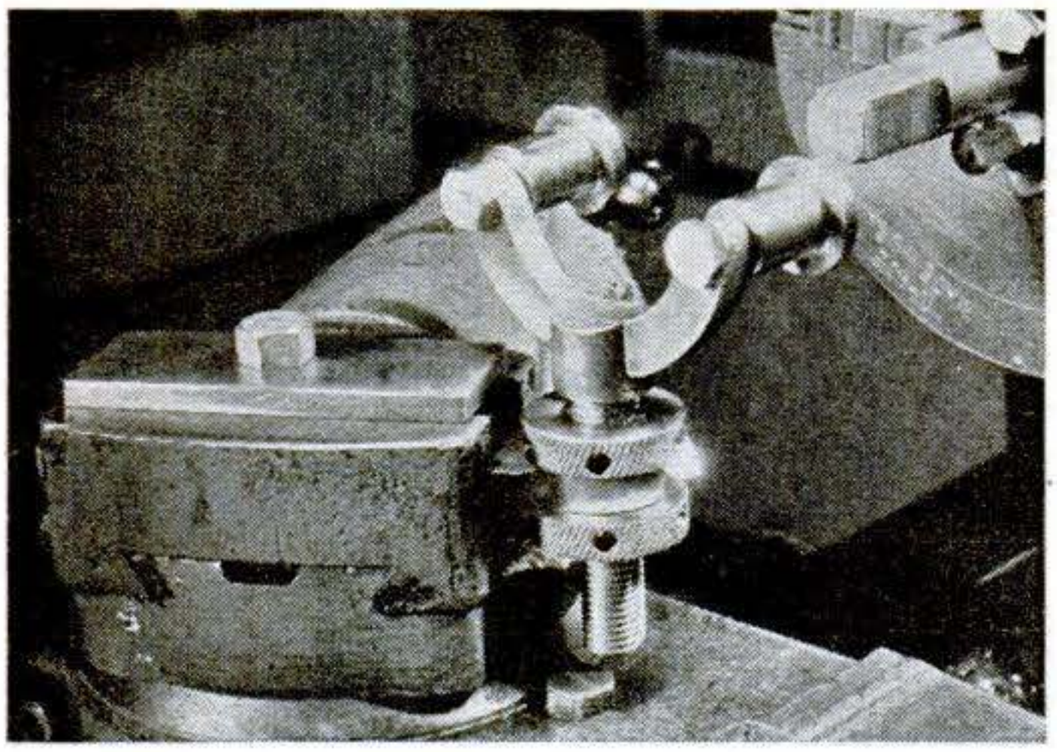


Drilling around the yoke, left above, lessens the sawing job. Adjusting nuts, right above, are turned and knurled on a threaded mandrel.



Speedily set up, the rest is still capable of highly accurate shaping. The chucked work is locked stationary when a flat is being filed.

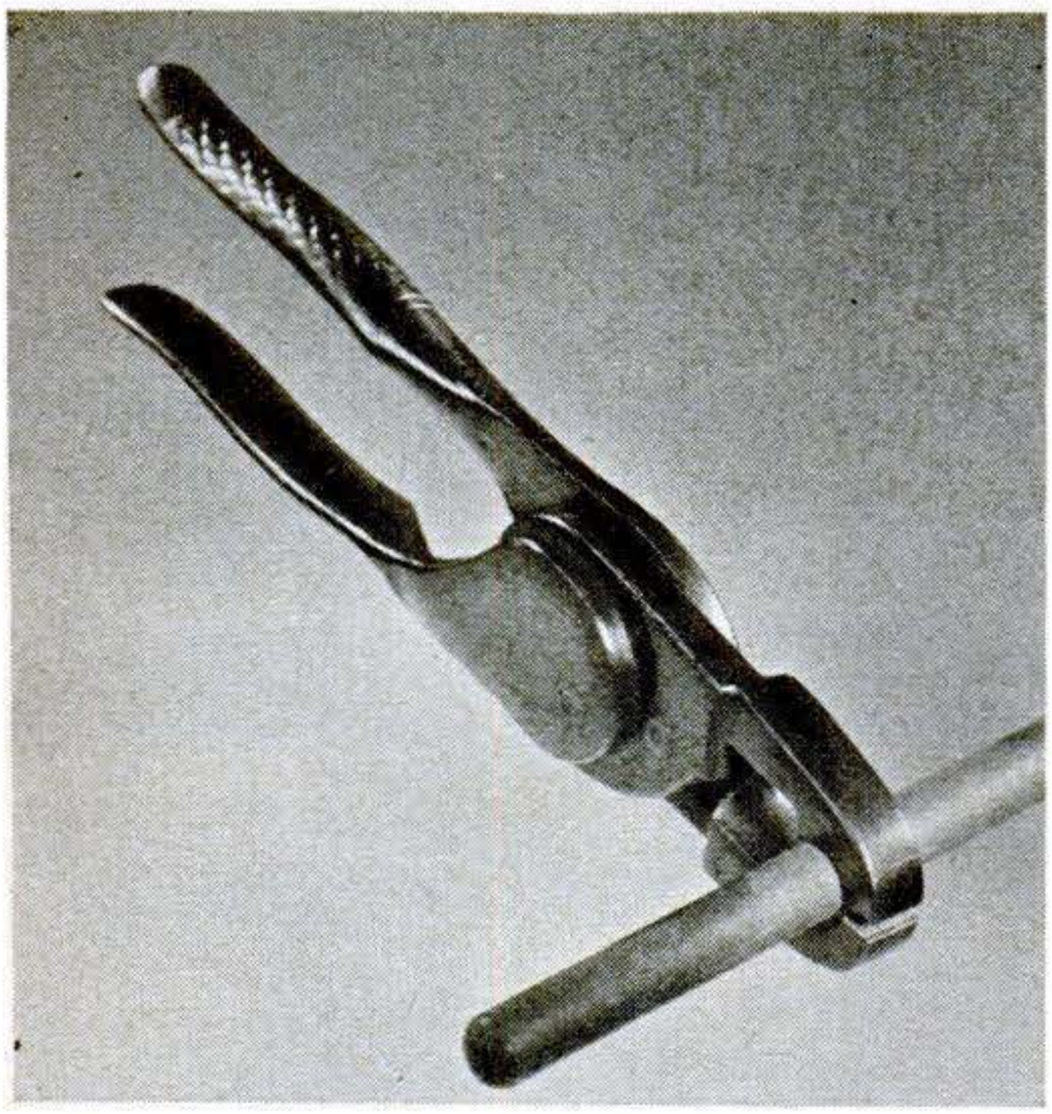
speed this job, though you'll have to file part of the inside.

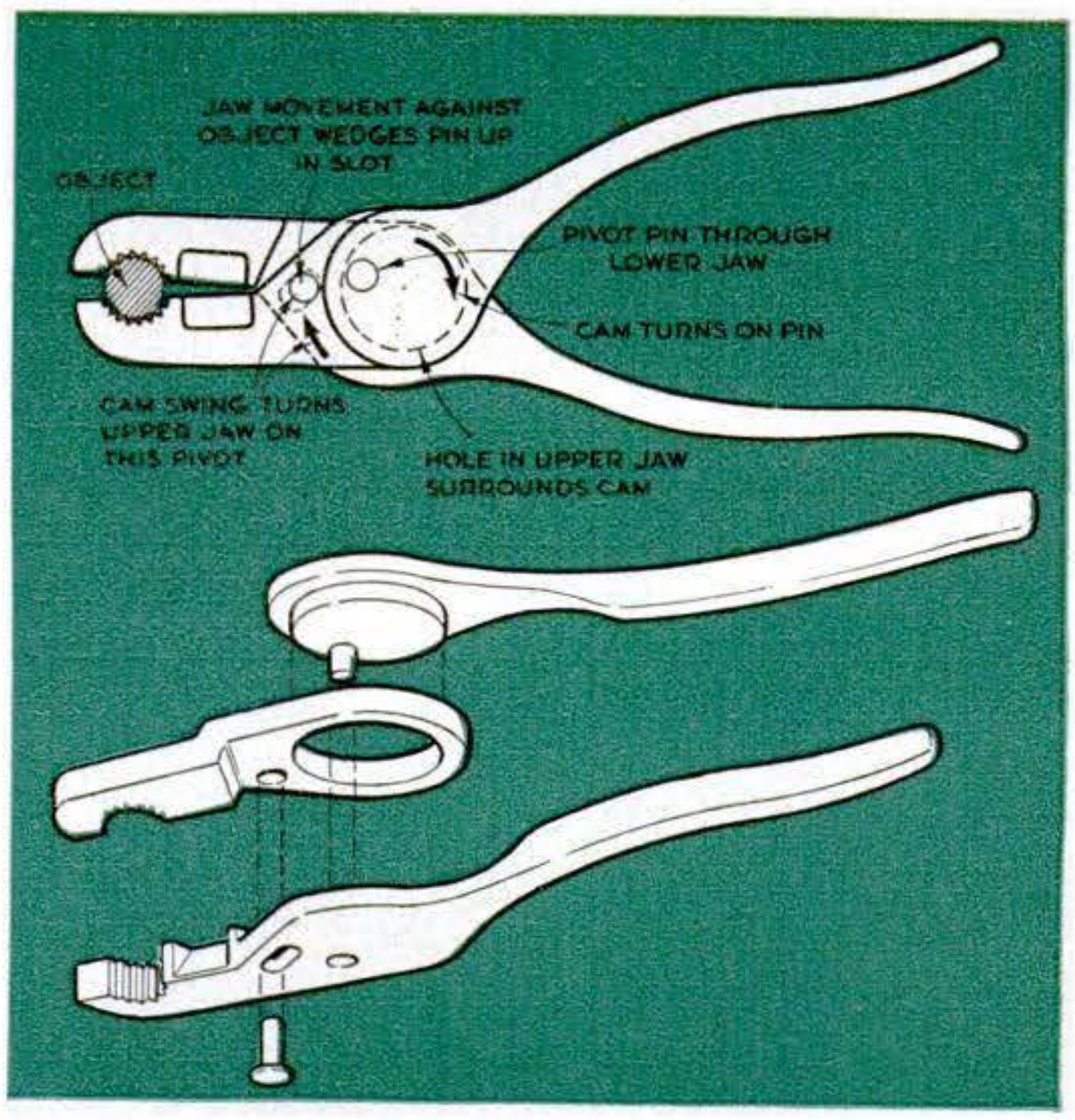
For the rollers, tool steel or drill rod hardened after shaping is preferable. Turn them back to back from a piece of ¾″ stock, drill and ream them 9/32″, and cut apart. The pins and nuts are made of mild steel. With the rollers mounted, they should turn smoothly but without play or shake.

The adjusting nuts are roughed from ¼″ flat steel, drilled and tapped, and mounted on a threaded mandrel for turning and knurling. Use the lathe indexing device to spot the five equally spaced radial pin holes. Cut the clamp shoe and compound-rest plate from flat steel also. Use needle files to shape an undersize hole in the latter so that the screw with the flat slides through easily but not sloppily.

In use the rest is locked up with the rollers slightly above the desired final surface, and the work is filed until the file stops cutting. The nuts are then adjusted for the finish cut. This can be done very accurately, since moving a nut a fifth of a turn (the distance from one hole to the next) will alter the height .010″.—*Will Thomas, Kenmore, N. Y.*

New Compound-Action Pliers Lock onto Work





If you close the jaws of this new pair of pliers on any solid object and squeeze the handles, the pliers will remain locked on the work like a clamp. To release the jaws, the handles must be pulled apart.

Called Lock Line® and made by the Ross Manufacturing Company, of San Francisco, the pliers are especially useful for situations where an extra hand seems needed. A tricky compound-leverage system that uses a cam to exert pressure against one of the jaws permits application of great force. As detailed in the upper part of the drawing above, locking is secured by means of a pivot pin that is free to move and wedge in a short slot. The jaws have hardened cutter edges.

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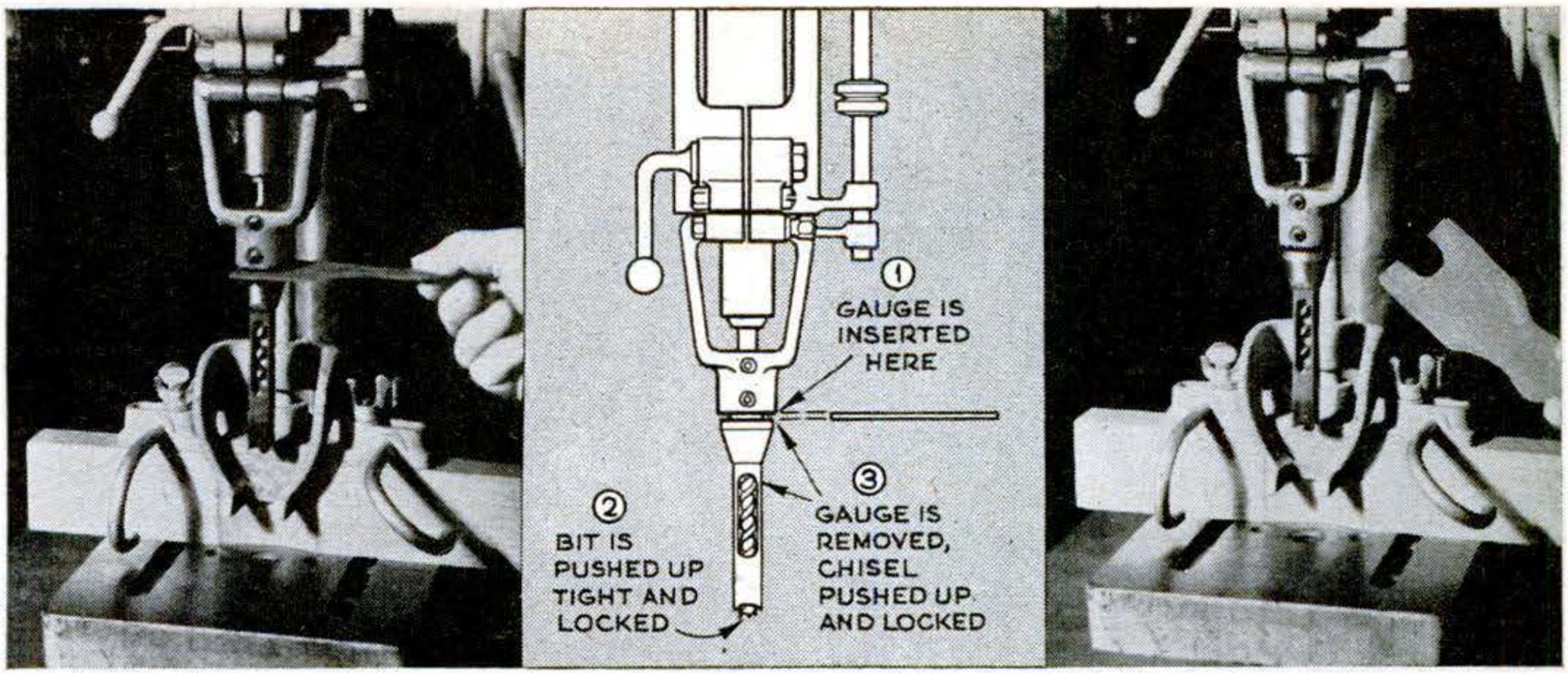
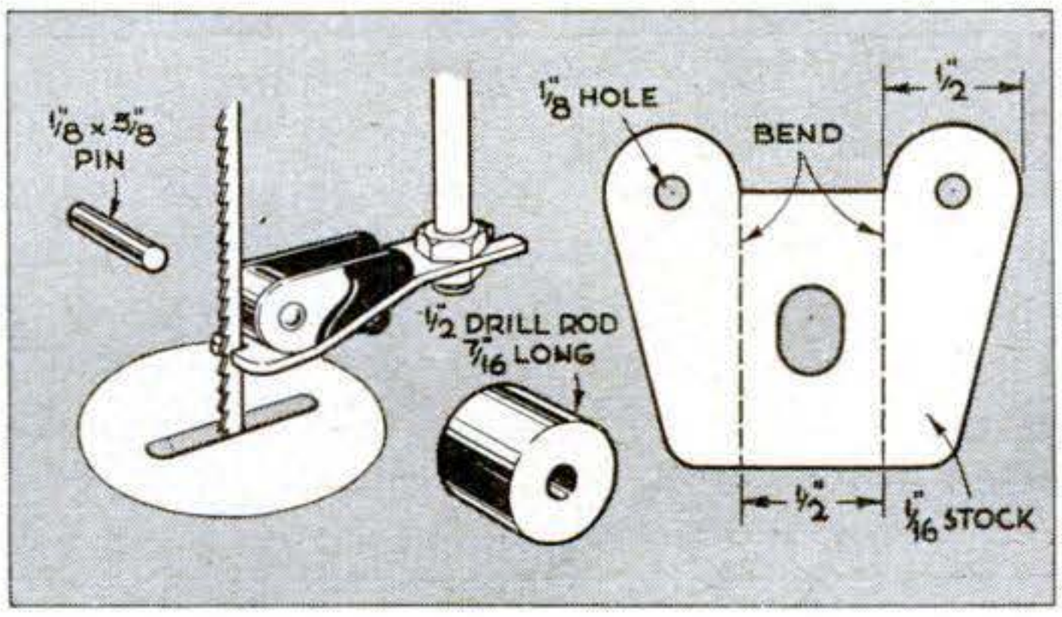


Gauge Sets Mortising Chisel to 1/16" Clearance

MORTISING-chisel bits should have about 1/16" clearance between the tip and the square end of the hollow chisel. Some workers make this setting by eye, usually none too reliably. The gauge shown in use above will do it quickly and accurately.

The gauge can be cut from any 1/16" material—for instance, brass, copper, aluminum, or fiber. Cut a rounded notch about ⅝" wide in the working end.

To set the bit, insert the gauge between the chisel shoulder and holder (1). Then push up the bit into the hollow chisel and lock it (2). Finally, remove the gauge and move up and lock the chisel. This gives the clearance.—*J. B. Leeth, Cullman, Ala.*



Roller Backs Up Jigsaw Blade

IN TIME, the slotted blade guide on some jigsaws wears so deep that it serves little purpose and the teeth may be damaged by striking the sides. A roller support behind the blade will eliminate this.

Make the roller from a 7/16" length of ½" drill rod, drilling it for an axle cut from ⅛" drill rod. Lay out a holder as shown on 1/16" sheet, bend to shape, and assemble by riveting the ends of the roller axle. Attach to the original blade guide with a 3/16" bolt. Notice that the hole for this in the holder is elongated to permit adjustment. First, set the guide so the back half of the blade rides in the slot without touching. Then bring up the roller until it just barely touches the back of blade.—*Ralph S. Wilkes, Elbridge, N. Y.*

Table Has Built-in Fan

IN THE base of this round table there's a three-speed fan that circulates air throughout the room. Height and diameter of the glass-topped table are 18". The fan is powered by a 1/15 hp., 115-volt AC motor. Howard Industries, Inc., of Chicago, prices the unit at about $55.

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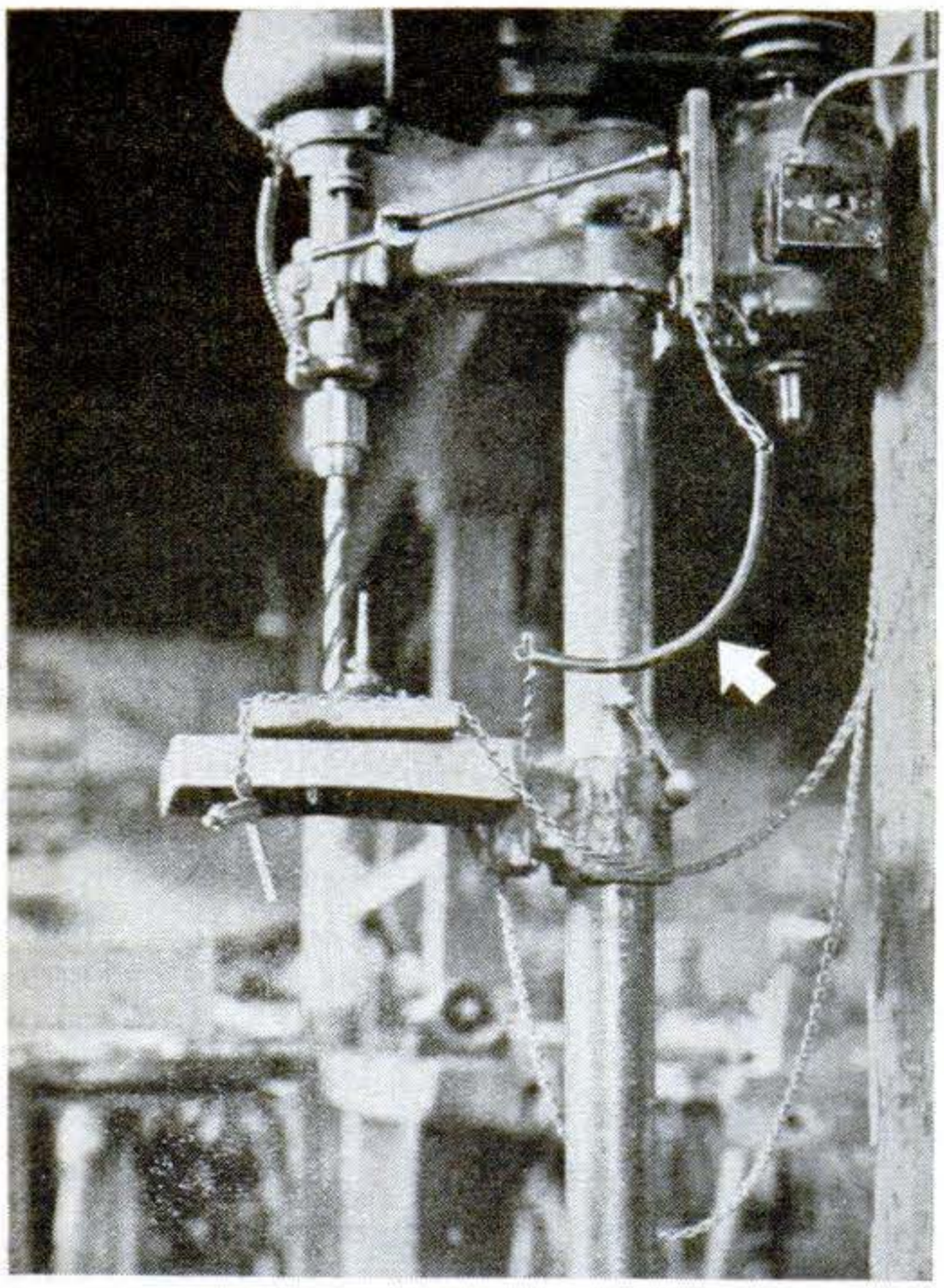
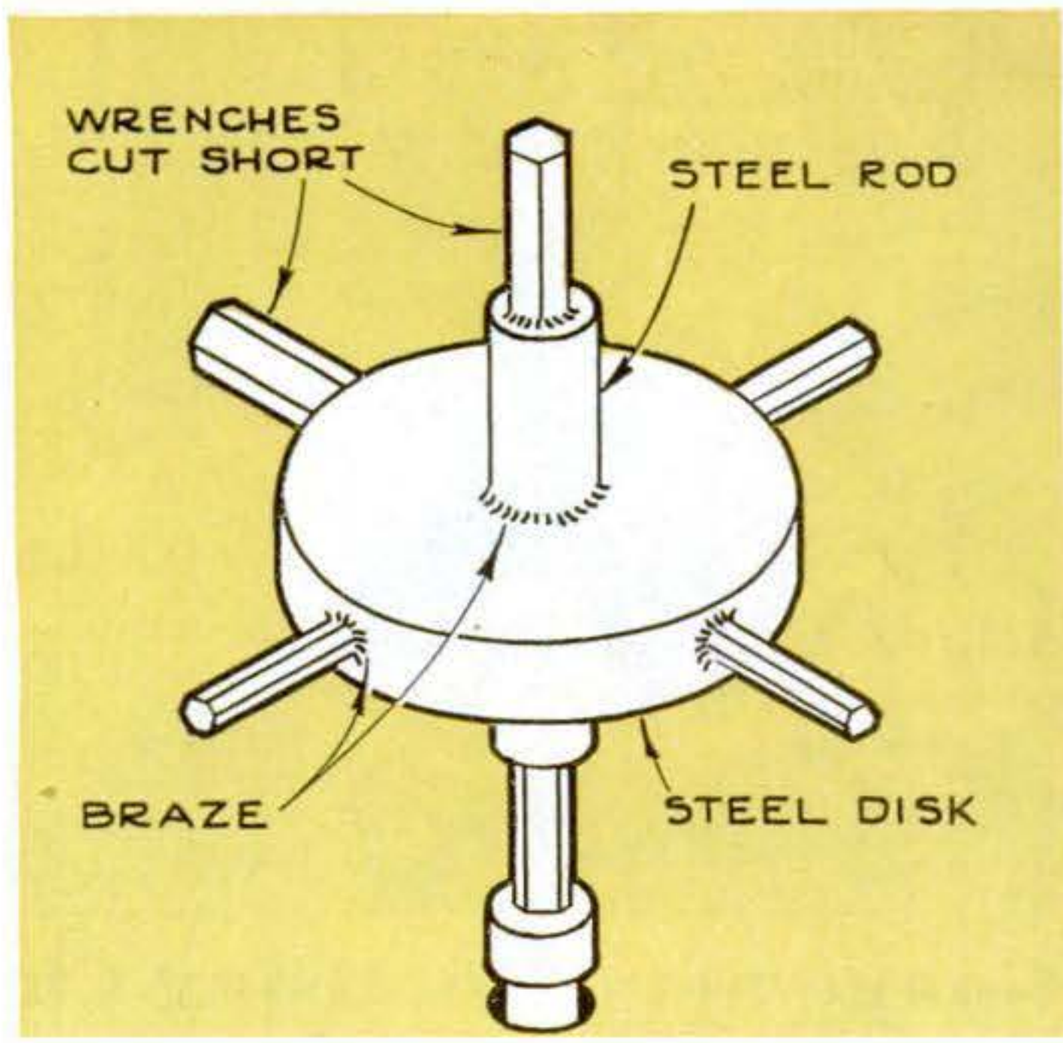
NEW SHOP IDEAS

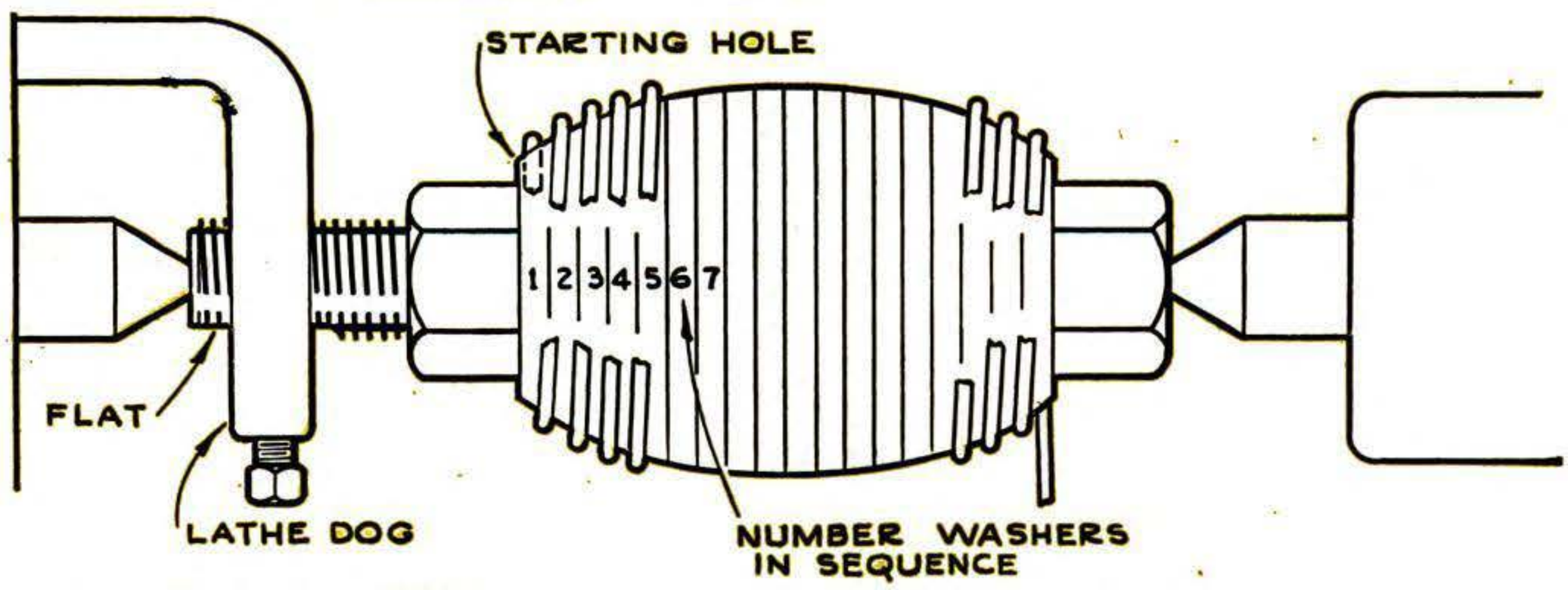


Drill-Press Chains. In our school shop we've found good use at the drill press for three lengths of light chain. One keeps the chuck key from straying, and another does the same for the cutting-oil can. The third, protected with a spring (arrow), stops the table if the clamp is carelessly loosened.—*E. V. Reyner, Townsend, Mont.*



Homemade Wrench Set. If you find yourself wasting time hunting for the right wrench to fit a hollow-head cap screw or setscrew, this keep-'em-together wrench may help. It won't give as much swing in close quarters, but it will often save time.

Drill four radial holes in a steel disk, sizing each one a trifle less than the major diameter of the wrench to go in it. In a center hole braze a stub shaft having similar end holes. Cut off six wrenches close to the bend (grinding and breaking is a fast way to do this), drive them in their holes, and braze in place. If this anneals them, reharden by heating and quenching. —*Clifford T. Bower, London, England.*



Winds Special Springs. Here's how we turned out a batch of special oval springs. We put some big washers on a centerdrilled bolt, tightened the nut, and turned between centers to the oval shape required. The washers were numbered for reassembly, and a starting hole drilled. After winding on the spring wire in the lathe, we removed the nut and slipped out the washers.—*R. E. Paquin, Worcester, Mass.*

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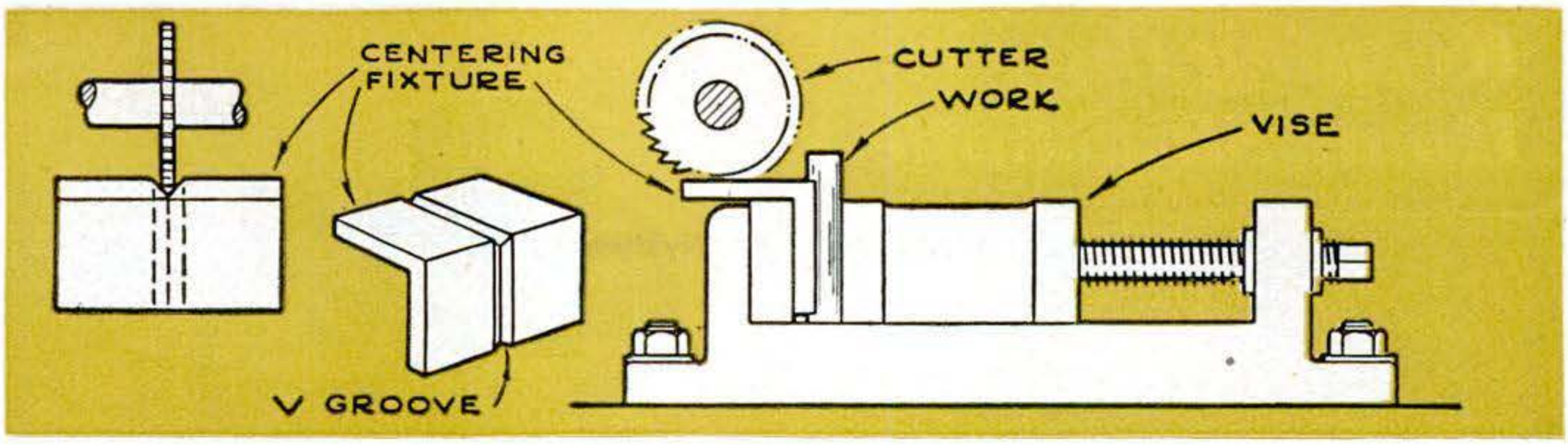
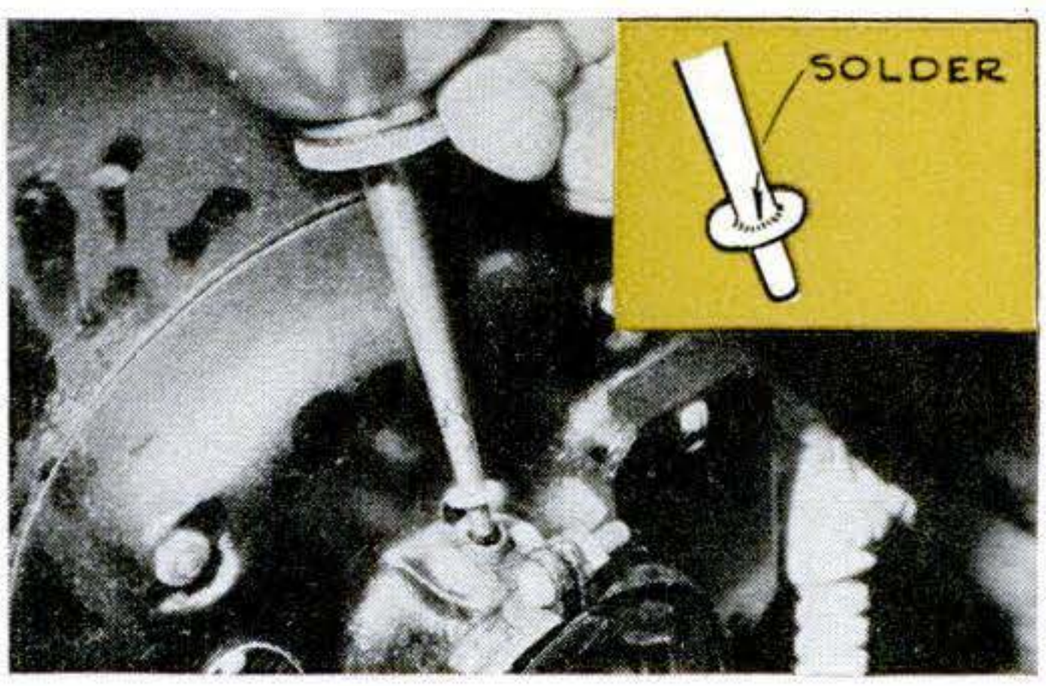
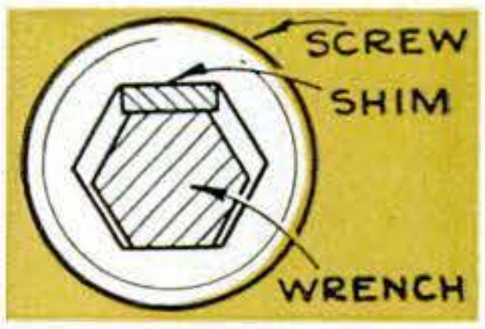


Aligns Milling Cutter. Setting up a milling machine to slot the end of a short rod ordinarily takes time and arithmetic. With this fixture it can be done just as well and much faster. It is a piece of angle steel exactly as long as the machine-vise jaws are wide, and provided with a V groove in line on both outer faces. For a single job, clamp the angle and work together and adjust the table until the cutter touches both sides of the V notch equally. In repeat work, do this for the first piece, and with subsequent ones be sure the fixture is flush with the sides of the jaws.—*H. Moore, Leeds, England.*

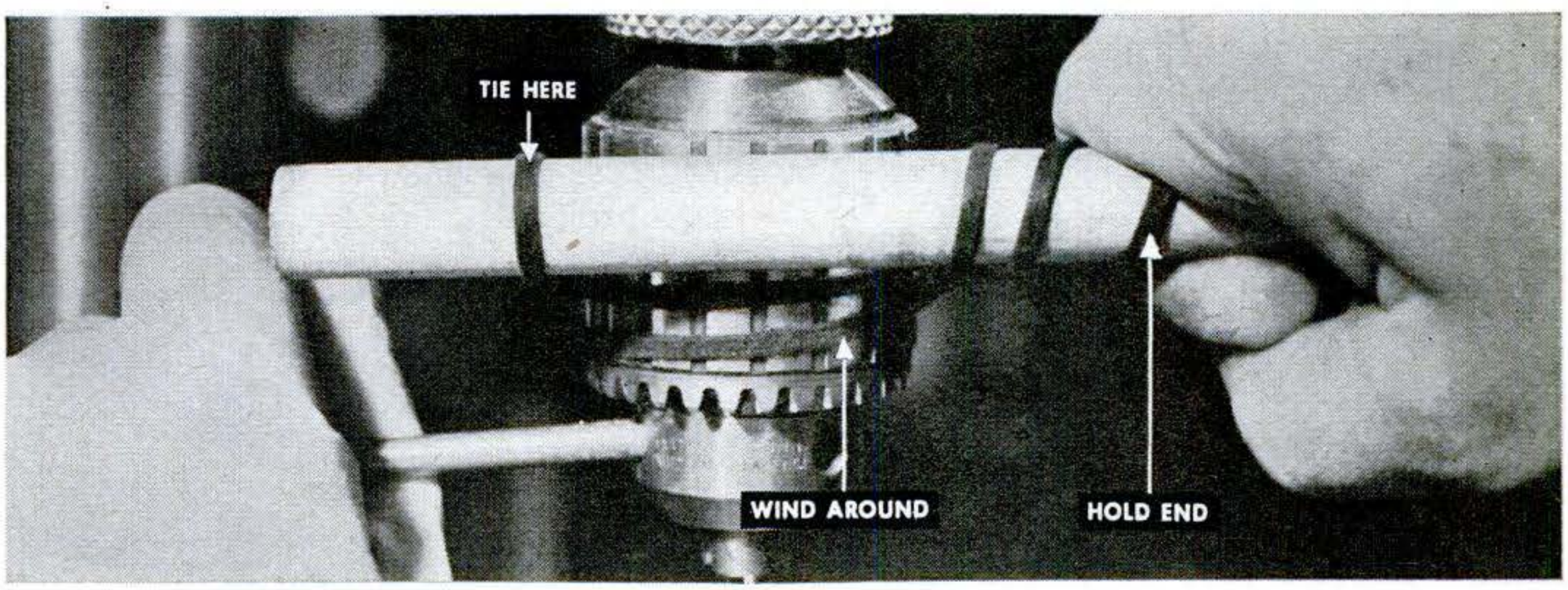


Washer Aids Oiling. Ever wish you had three hands when trying to put an exact amount of oil in a spring-capped oil cup? Solder a washer ¼″ from the tip of the spout. The washer holds back the cap while you count the number of oil drops.

Soot Shows Heat. When to start welding or "brazing" aluminum is a problem because there is no red glow at the right temperature. A good stunt, suggested by All-State Welding Alloys Co., White Plains, N. Y., is to coat the work first with soot, which disappears at about 900° F.



Hex Fix. If you've mislaid the right wrench for a hollow-head screw but have one that's too small to serve, try shimming it out with a bit of flat steel. A ground-down piece of broken power-hacksaw blade will often do.—*F. Strasser, Santiago, Chile.*



Substitute Key. When you lose a chuck key and must use the chuck before getting a new key, this rig will help out. Use a 1′ length of ⅝″ maple dowel, a leather thong or shoelace, and a 5/16″ steel rod for the hole in the chuck body. Wrap the thong around the chuck barrel several times and wind the free end around the dowel. Though awkward, the setup will open or close the chuck tightly enough for most purposes.

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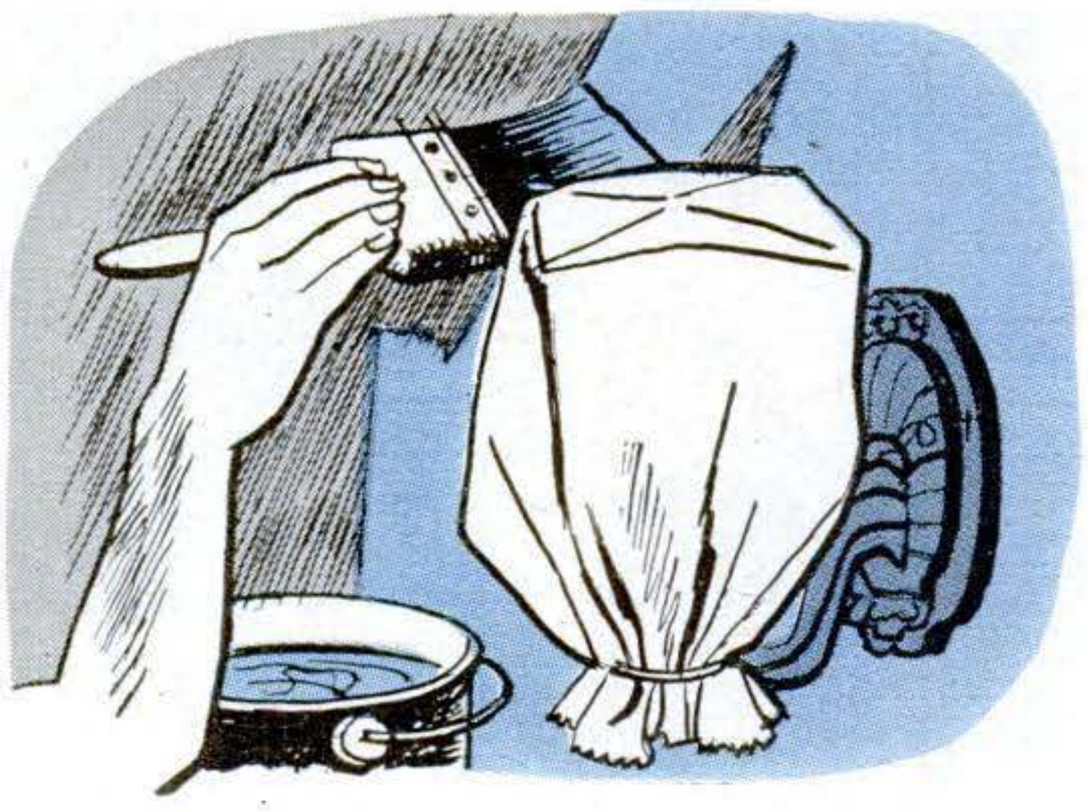
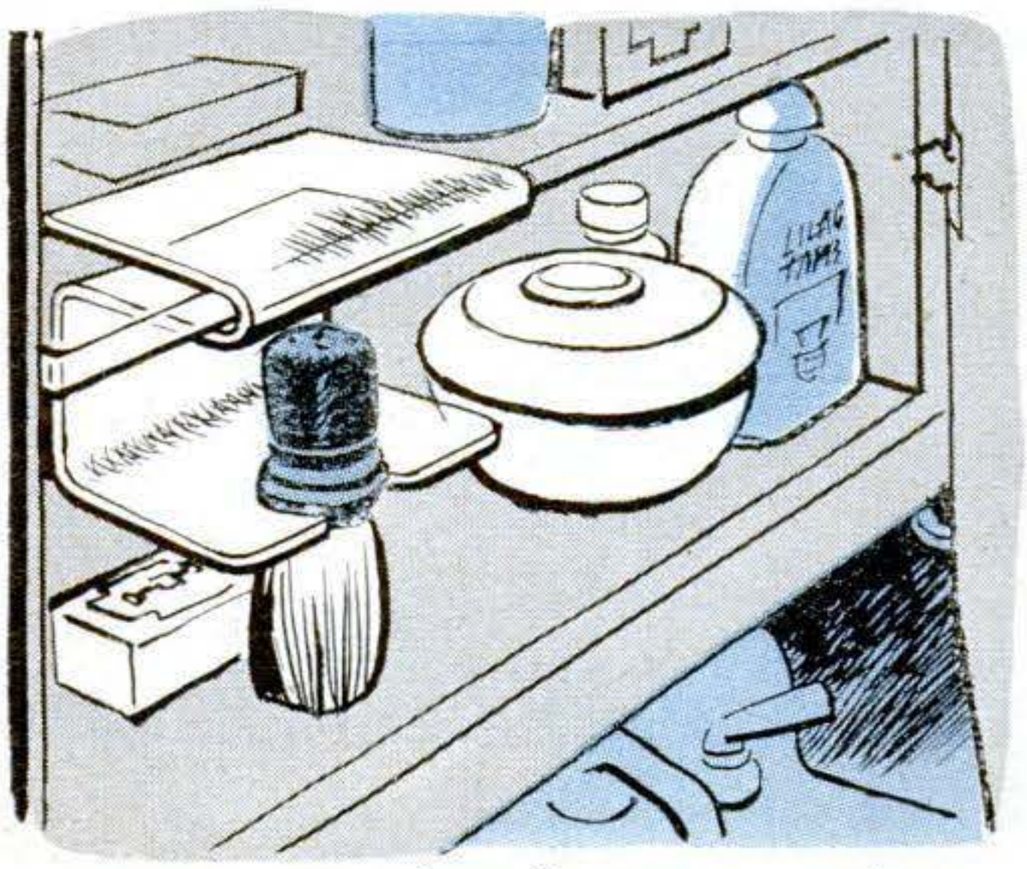
Keeping the Home Shipshape

Fastening two bread pans to the inside of a closet door gives you handy receptacles for stowing wallets, keys, change, and the like when undressing or changing your clothes.

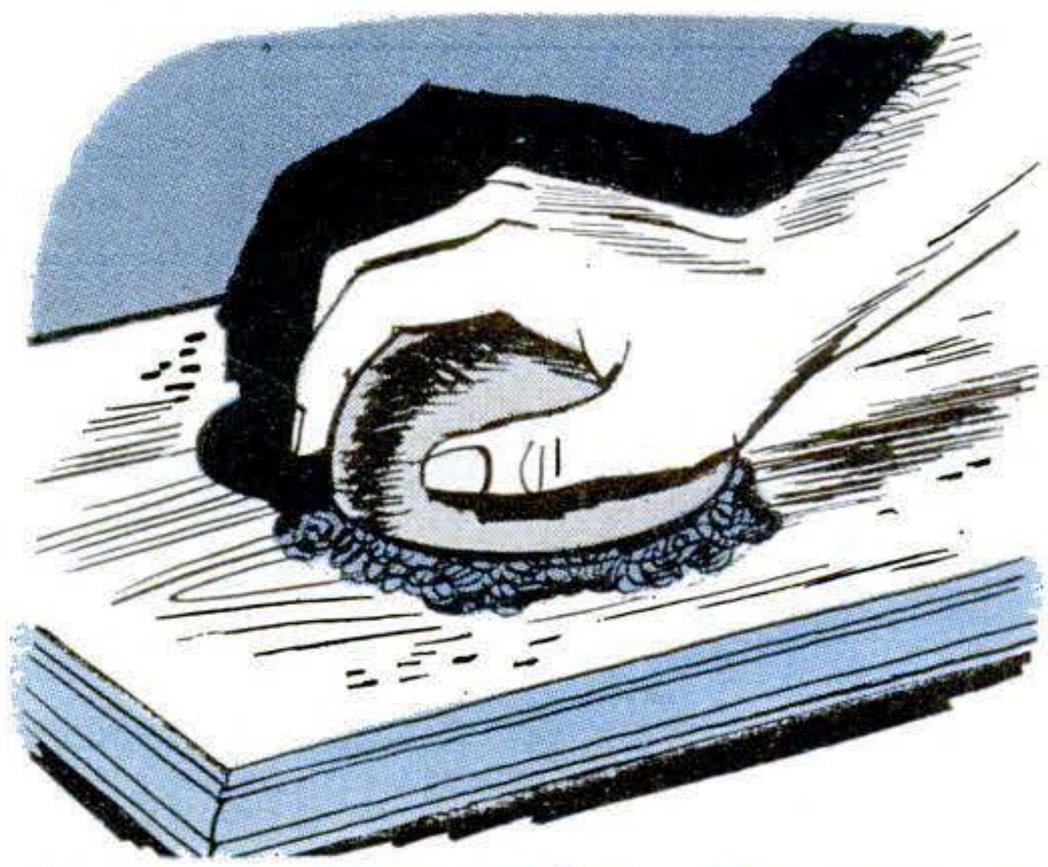
You won't have to hunt for a wiper after filling your pen if you attach a scrap of soft leather to the bottle. Punch a hole and loop a rubber band through and around the bottle.



Before you start to paint a room, slip paper bags over the light fixtures and tie them in place. It's easier to keep paint splatter off them than to clean up afterward.



A plastic clip, slipped over a medicine-cabinet shelf as shown, holds a shaving brush in proper drying position and helps keep the bowl clear. It can also be made of sheet metal.



Half a rubber ball makes a good holder for steel wool when used like this. The rubber is the right size and shape for the hand, protecting it from steel slivers and splinters.

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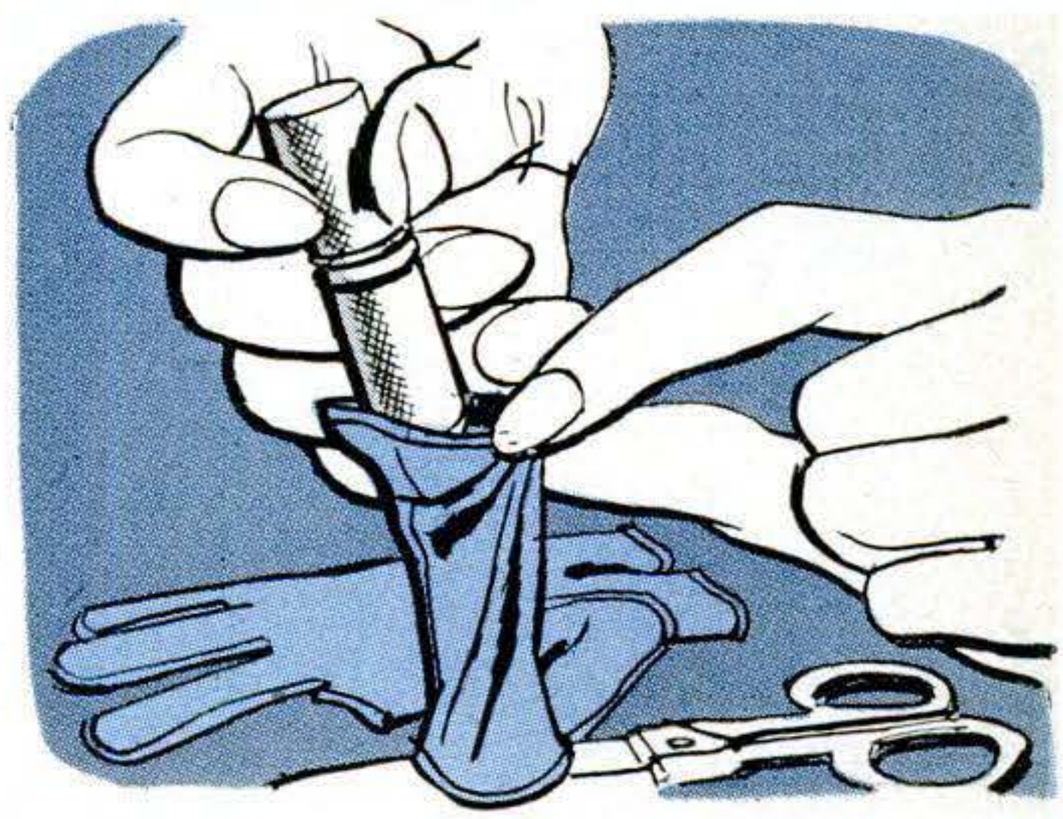
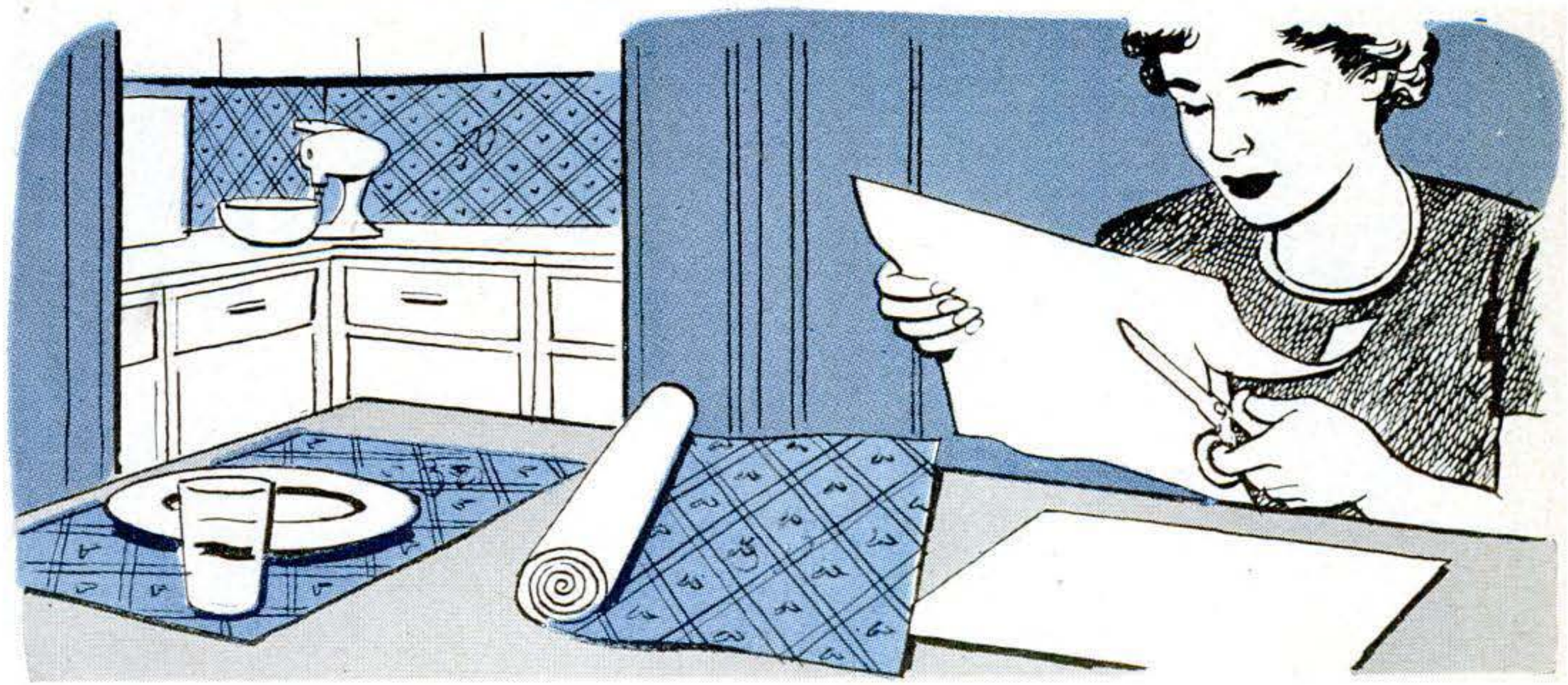
Clothes-snagging rough spots on furniture can be easily detected if you dust with an old silk garment or stocking. Keep a nail file handy to rub down any roughness you find.

Before sending a garment to the cleaner, pin a note on each stain telling what caused it. Some spots need special treatment, and the note helps a cleaner pick the best one.

Hang a plastic shoe bag in the back entry as a storage place for the family's rubbers and there will be no hunting on rainy days. Name tabs may be helpful if the household is large.



To keep a shiny new lipstick case from getting scratched in your purse, make a cover for it by cutting a finger off an old leather glove. Make sure the glove is soft on the inside.



Use left-over kitchen or dining-room wallpaper to make a set of place mats. Trim the borders and cut 12″ sections. A coat of shellac will help, especially if the paper isn't washable.

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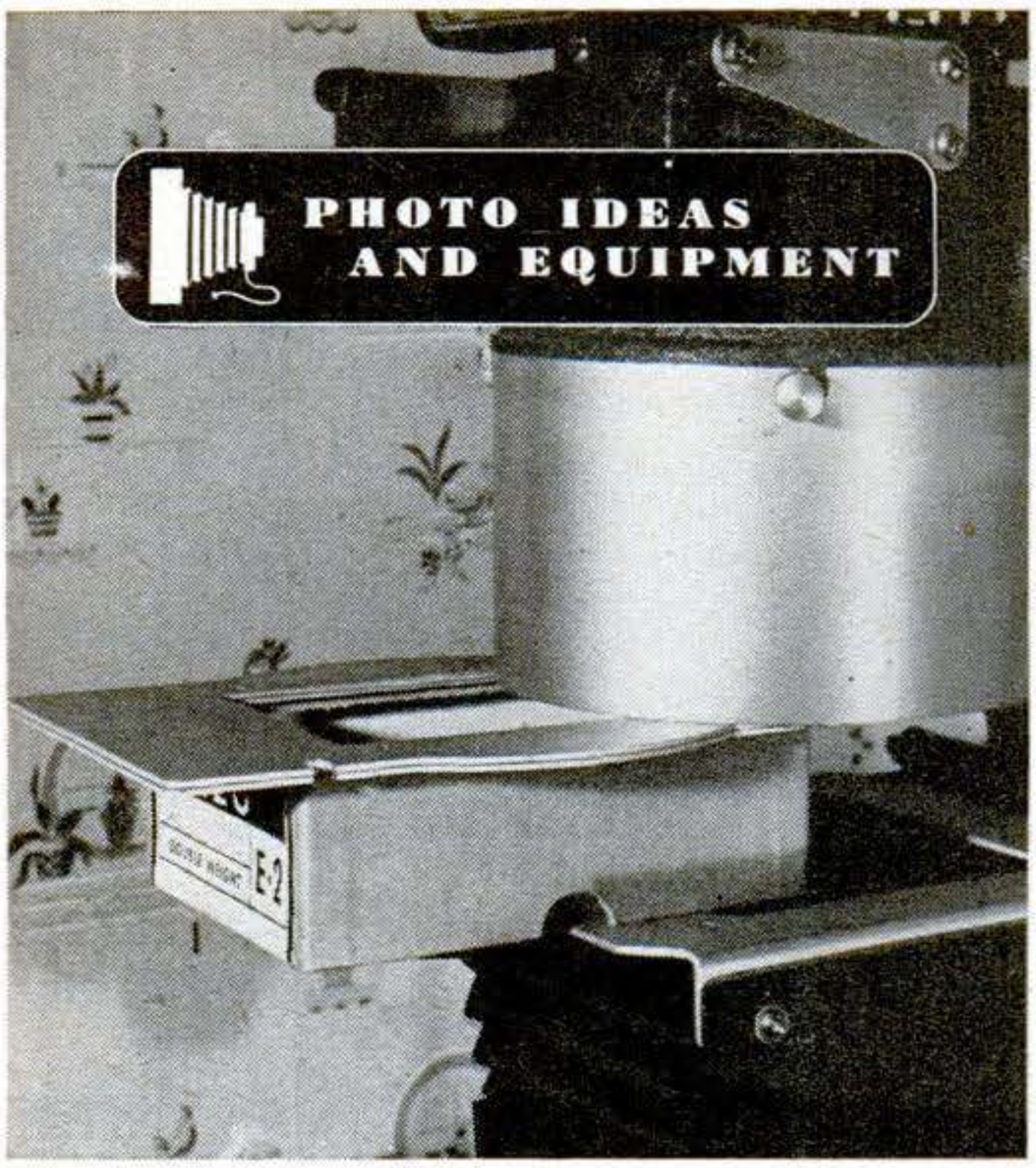
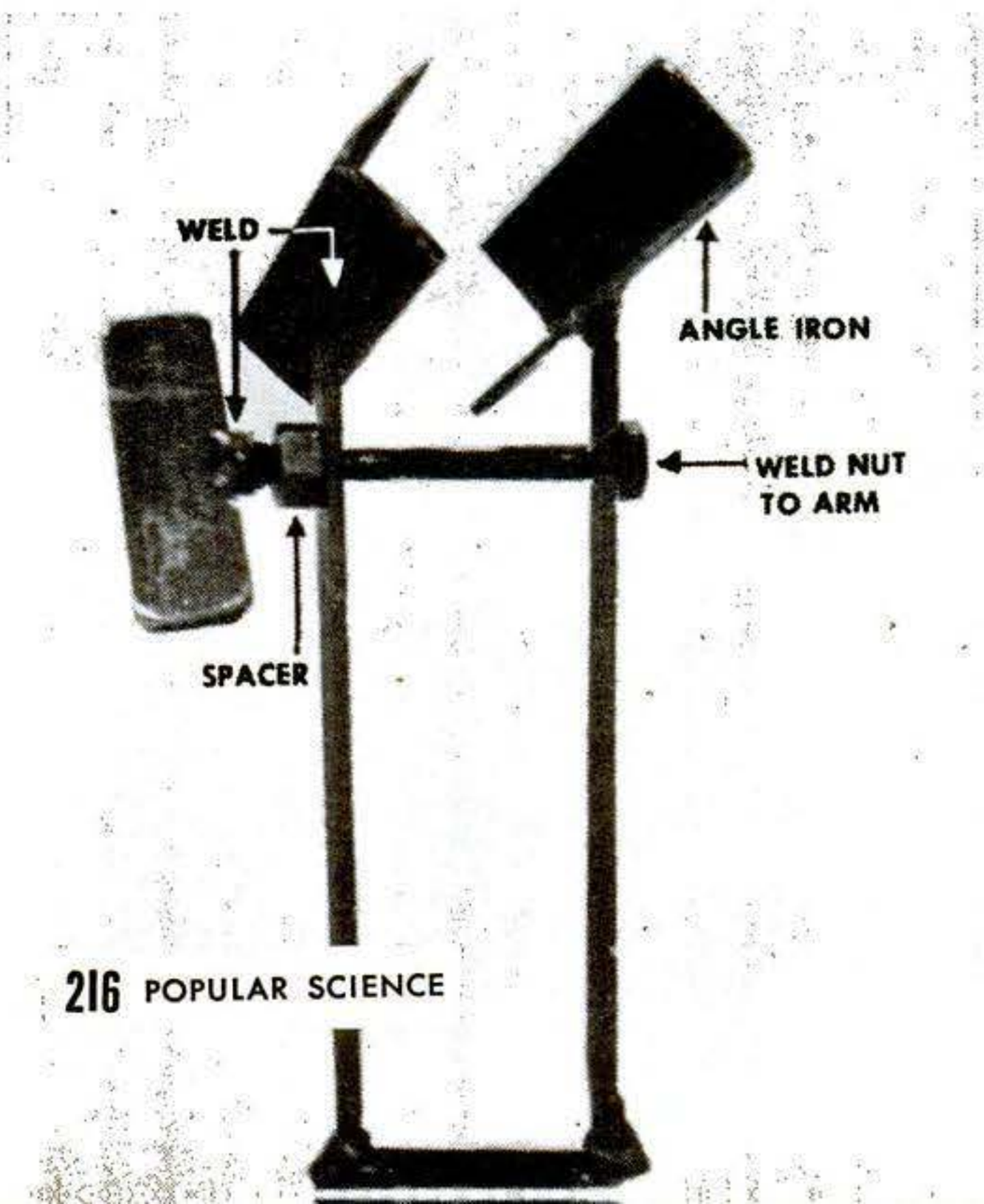


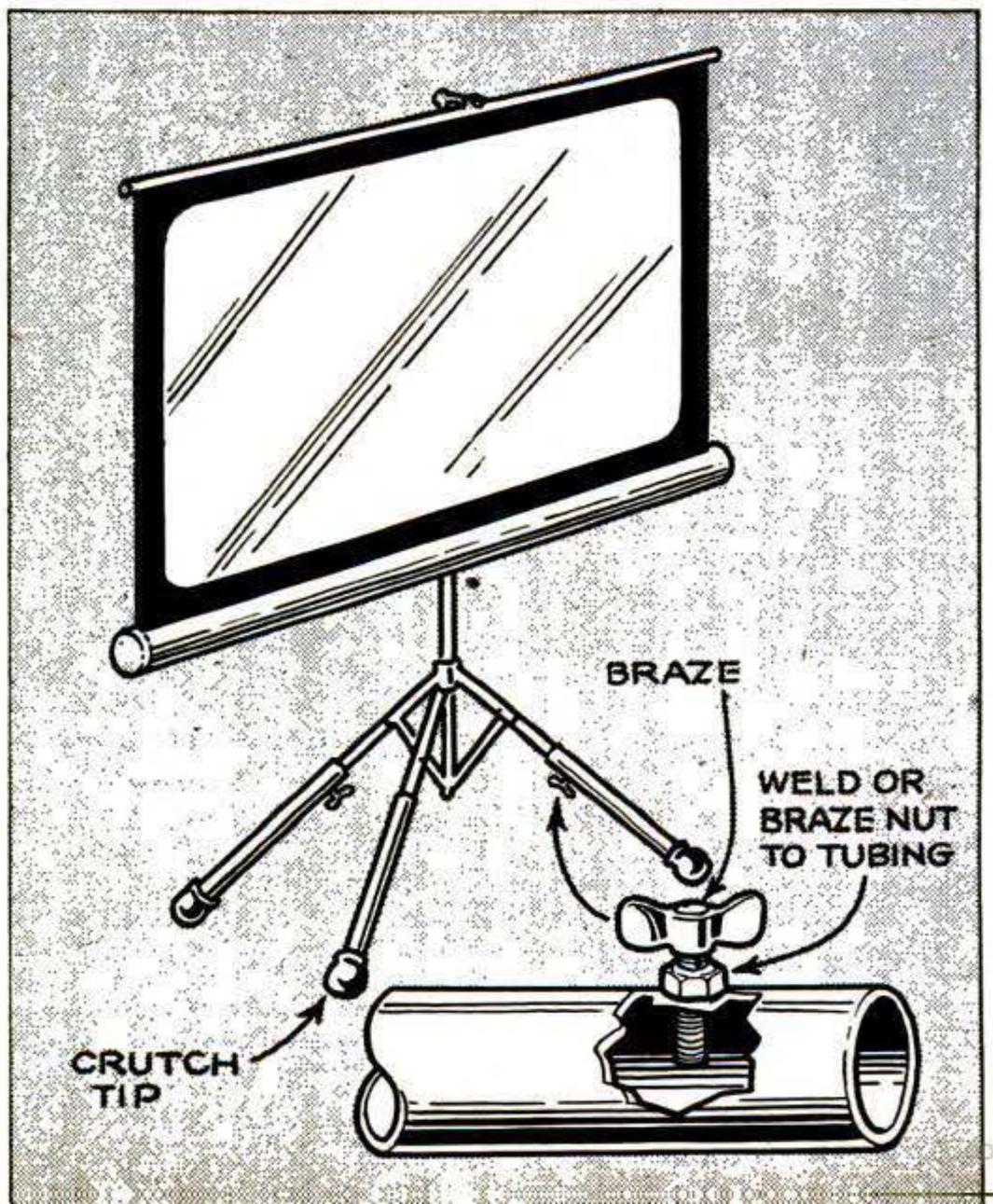
Enlarger Reduces. One-to-one, or smaller, prints may be made with an Omega D-II® enlarger by increasing the distance from film to lens as shown in the above photo. In the top of a cardboard box, cut a hole large enough to accommodate the negative. Place the negative carrier on the box top and slip box and carrier under the condensers.—*E. H. Johnson, Jr., Philadelphia.*

Automatic Exposure Control. A photoelectric cell, built into the Eumig® 8-mm. movie camera, controls the shutter speed and also gives you the correct aperture setting. When you look through the view finder, you also see the pointer of the exposure meter. Centering the needle automatically sets the aperture. The distributor is the Arcap Mfg. Co., Los Angeles.

Enlarger Clamped to Pipe. When I set up my temporary darkroom, the clamp pictured below holds the enlarger to a vertical 2″ pipe. The 1½″ by 10″ angle irons are welded to the ¼″ by ⅞″ by 9″ pieces of spring steel. On the other end, a ¼″ by 2″ by 3″ plate is bolted to the enlarger. Before assembly, the arms were drilled for the ⅜″ by 4″ carriage bolt.—*Max Alth, Yonkers, N. Y.*

Tubing Raises Screen. Extension legs for a movie screen can be made from electrical conduit or other thin-walled metal tubing. Be sure the diameter of the tubing will fit over the screen legs. The extensions can be as long as you want. Braze or weld a 5/16″ nut to the tubing to take a wing bolt. Rubber crutch tips finish the extension legs. —*Charles H. Hardy, Los Angeles.*





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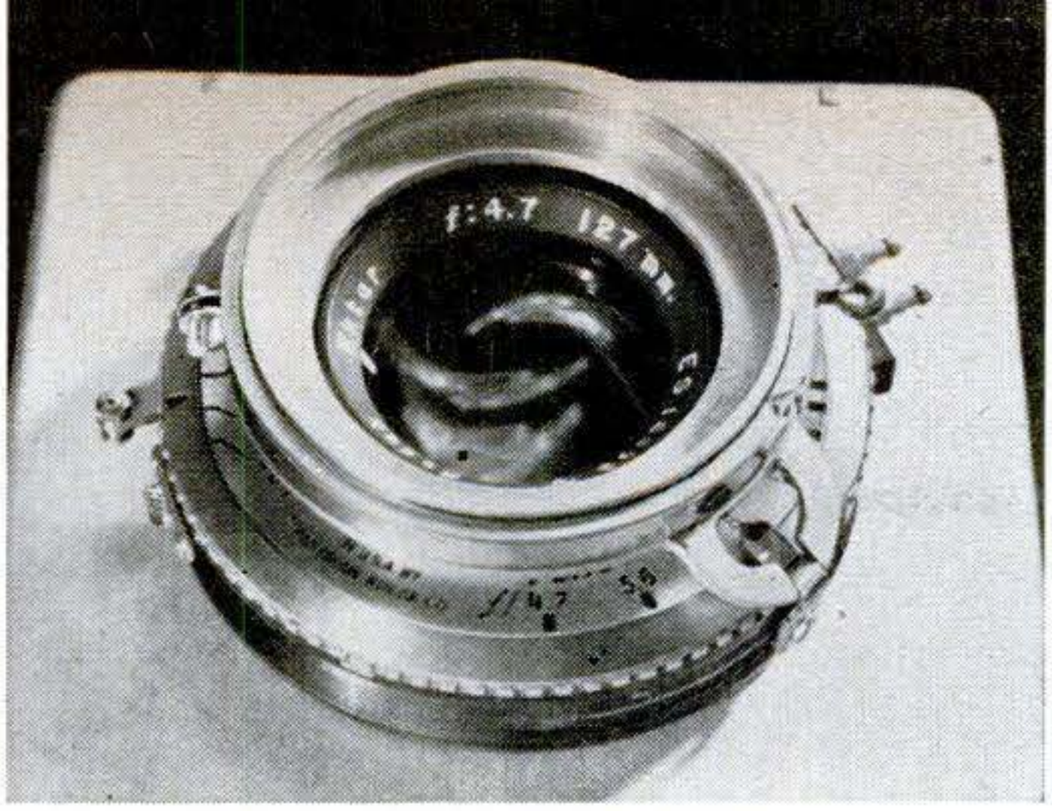
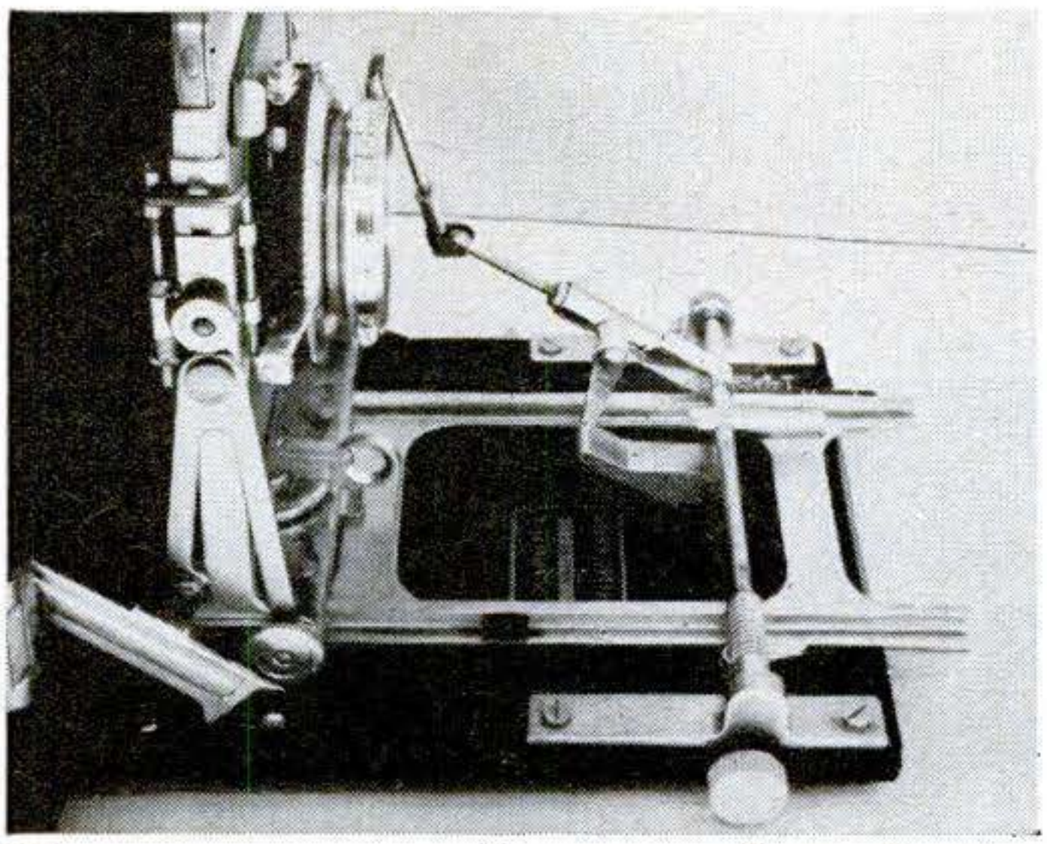
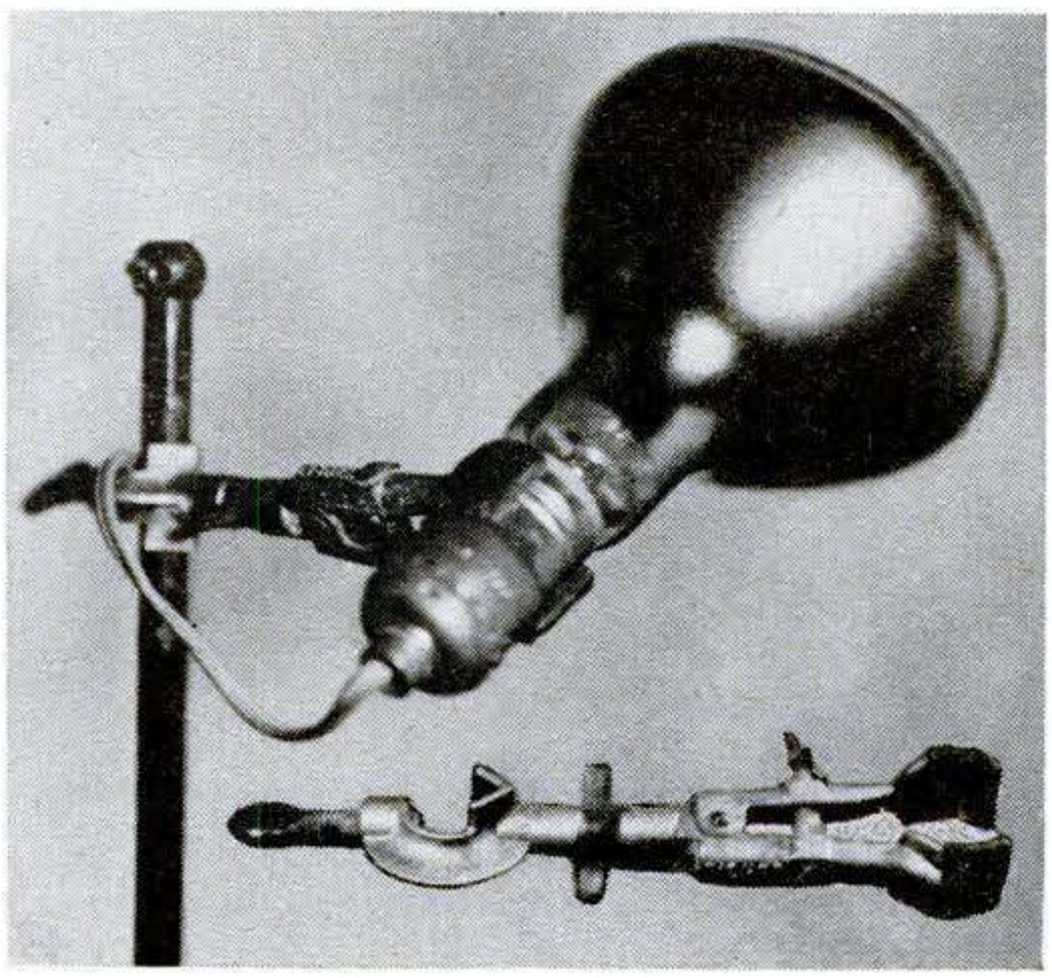


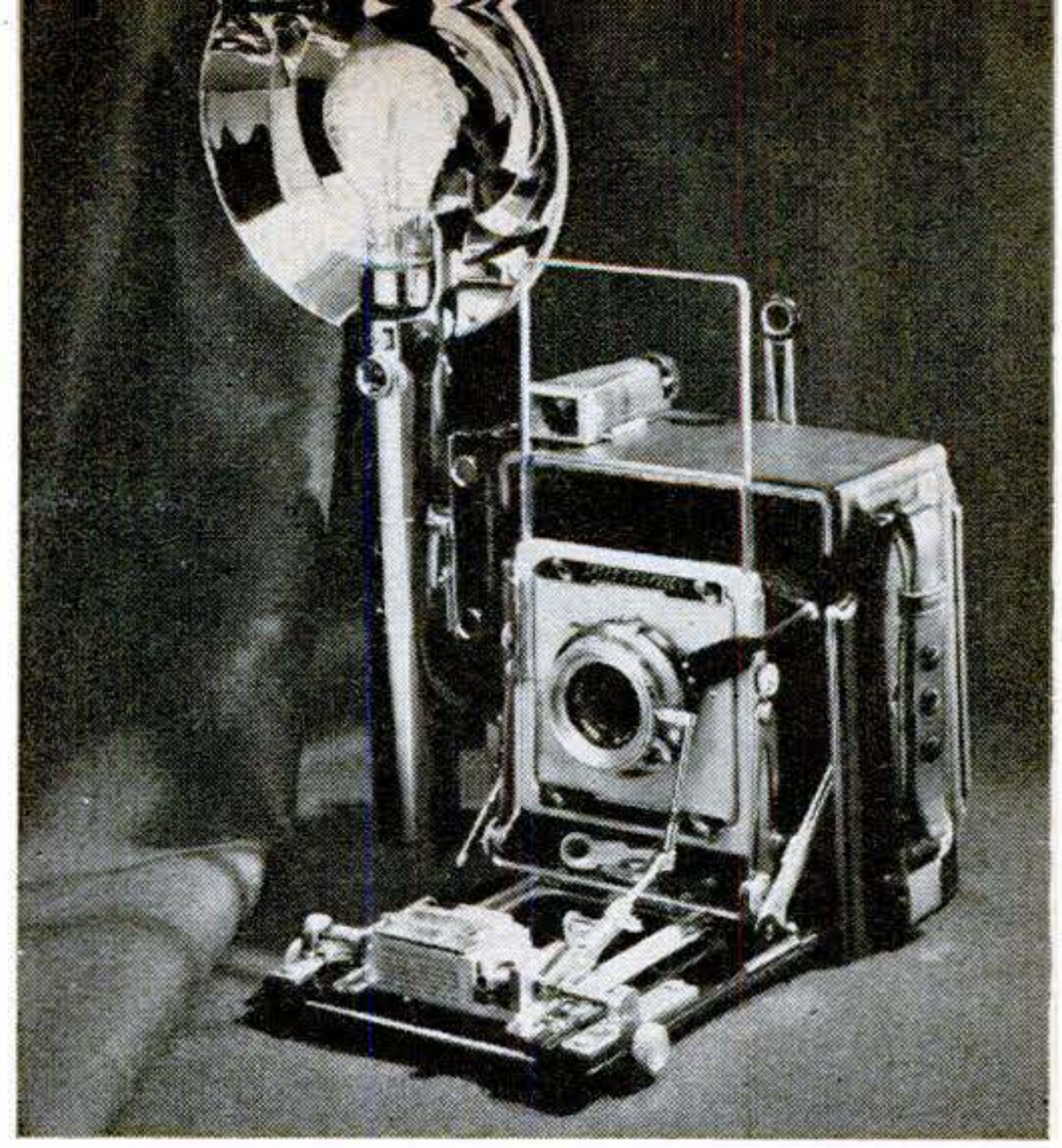
Closeup of lens mount with diaphragm-operating ring in place. Control arm has been taken off.



View across camera shows control arm. During focusing in usual way, arm adjusts diaphragm.

Burette Clamp Holds Lamp. Reflector-type flood and spot bulbs can be positioned conveniently with a burette clamp. Such clamps are available at chemical supply houses, usually for less than $1. A wing bolt holds one end to rods up to ½″ in diameter. Another bolt lets you swivel the jaws to any angle and lock them in that position.—*Edgar S. Castle, Highland Park, N. J.*





Simple to install, unit takes up small space and may be left on camera when it is closed.

Diaphragm Set Automatically. Photographers who must shoot flash pictures on the run will welcome Focoflash®. The control need be set only once. After that, all you have to do is focus and shoot. Focusing through the range finder automatically adjusts the diaphragm for the exposure. The setting takes into account all factors involved: type of reflector, kind of flash bulb, film speed, shutter speed, and conditions of exposure—whether the subject is light, average, or dark.

The control, smaller than a pack of cigarettes, can be attached without altering the structure of the camera. The initial model fits only 4″ by 5″ and 3¼″ by 4¼″ Pacemaker Speed® and Crown Graphic® fitted with 127 mm. Kodak Ektar® lenses. The manufacturer, HCE Co., Inc., of San Francisco, plans to bring out models to fit other cameras. Focoflash retails for $37.50.

Once installed, the unit may remain in place, since it does not interfere with closing the camera. The diaphragm-operating ring is threaded for a filter ring.

Simple Print Washer. Remove the handle of a plumber's helper and cut a hole through the rubber where the end of the handle was. Drive four small nails in the top and slot the bottom. Placed over a sink drain, it allows the water to escape while the nails keep prints from the hole.—*R. W. Breland, Colorado Springs.*

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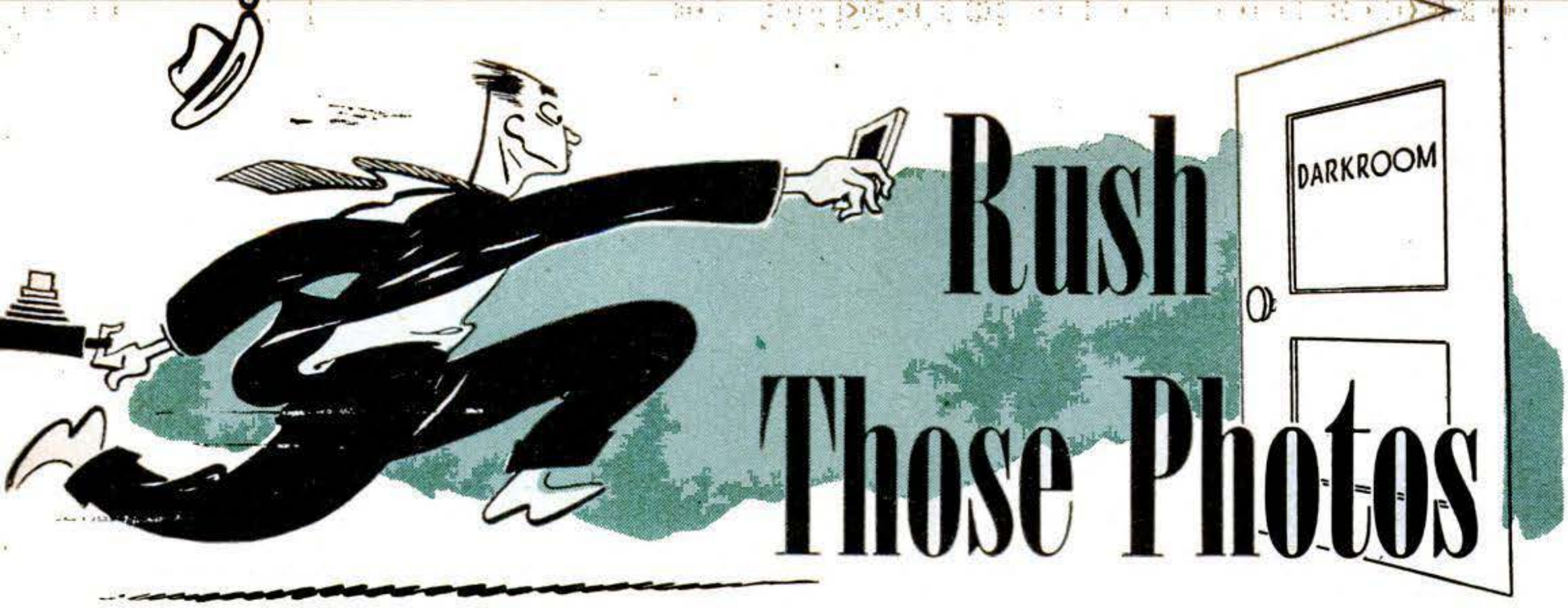


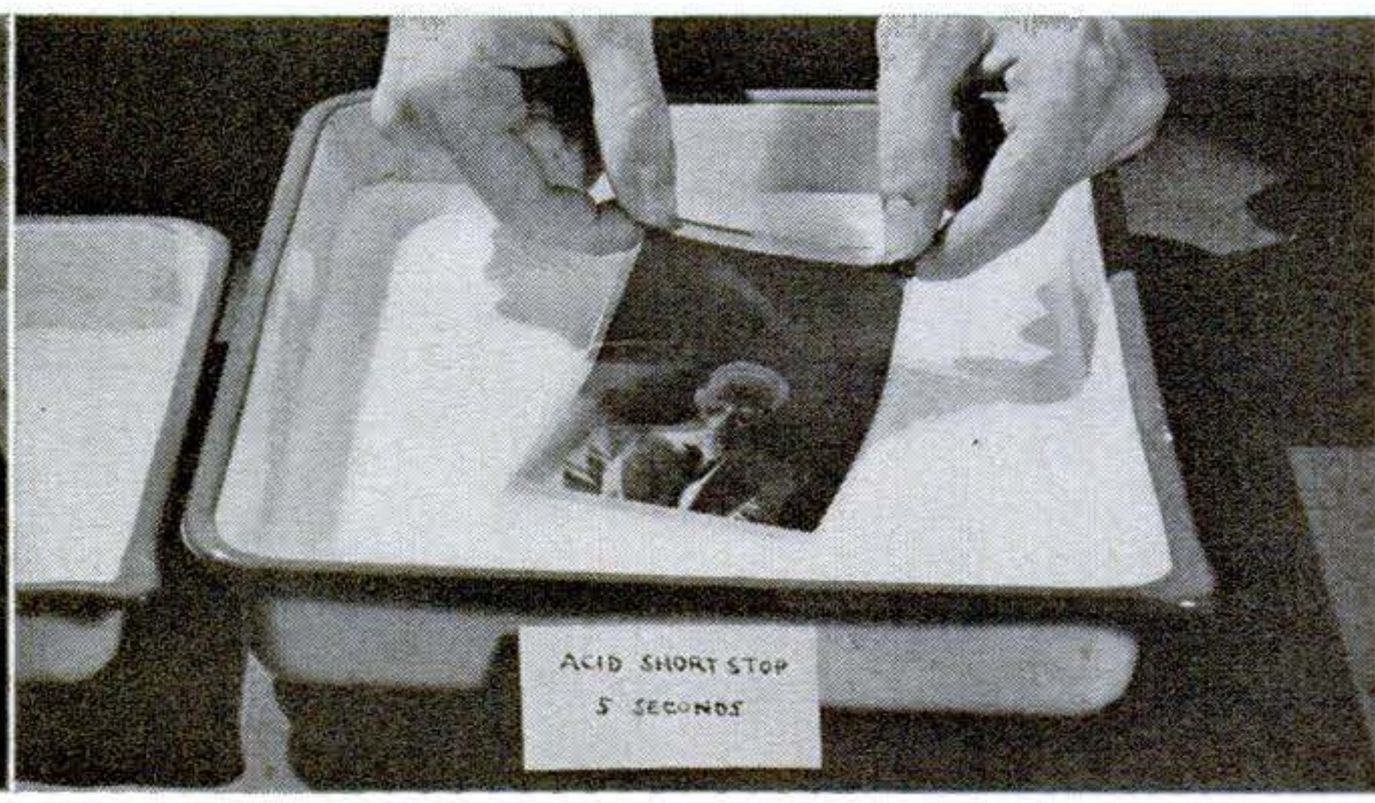
Rush Those Photos

Ever wonder how news photographers make prints so quickly? You can do the same—for fun or profit.

By Kenneth M. Swezey

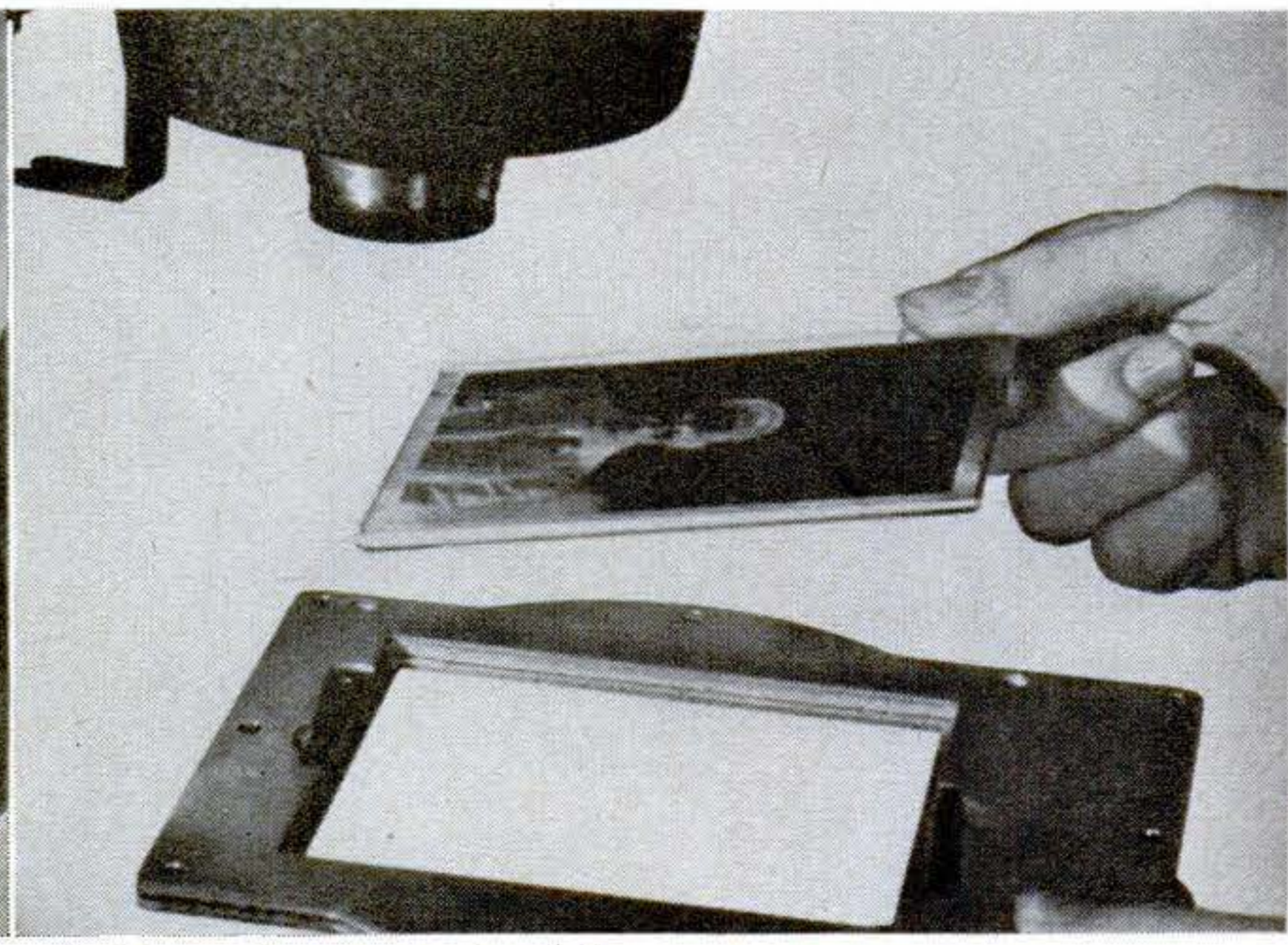
IN PHOTOGRAPHY, speed is spelled with a dollar sign. A photo developed and printed in a matter of minutes is often worth money. If you work fast, a shot with top news value will find a welcome from your

1. Quick developing is the first step. Use of a two-solution developer as above aids control of contrast. Single solution can also be used.



2. Agitate film 5 sec. in an acetic acid bath to stop development. Above 70° F., dilute this bath to prevent blister formation on negative.

5. Wipe surface water off the negative with a wad of cotton that you have wet and squeezed out. Put the neg on a ferrotype tin for this.



6. For enlarging, place the wet negative in a glassless carrier or squeegee it lightly on a single glass plate with emulsion side down.

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newspaper. Or perhaps you'd like to try your hand at night-club photography, snapping social groups—at dinners, parties, and the like—and delivering cash-on-the-line prints before the gathering breaks up.

Such photo-finishing demands shortcuts. You can't afford to dawdle. In newspaper darkrooms they do the job in six to ten minutes. You probably can't equal that, but you should be able to cut the time to 15 minutes or less.

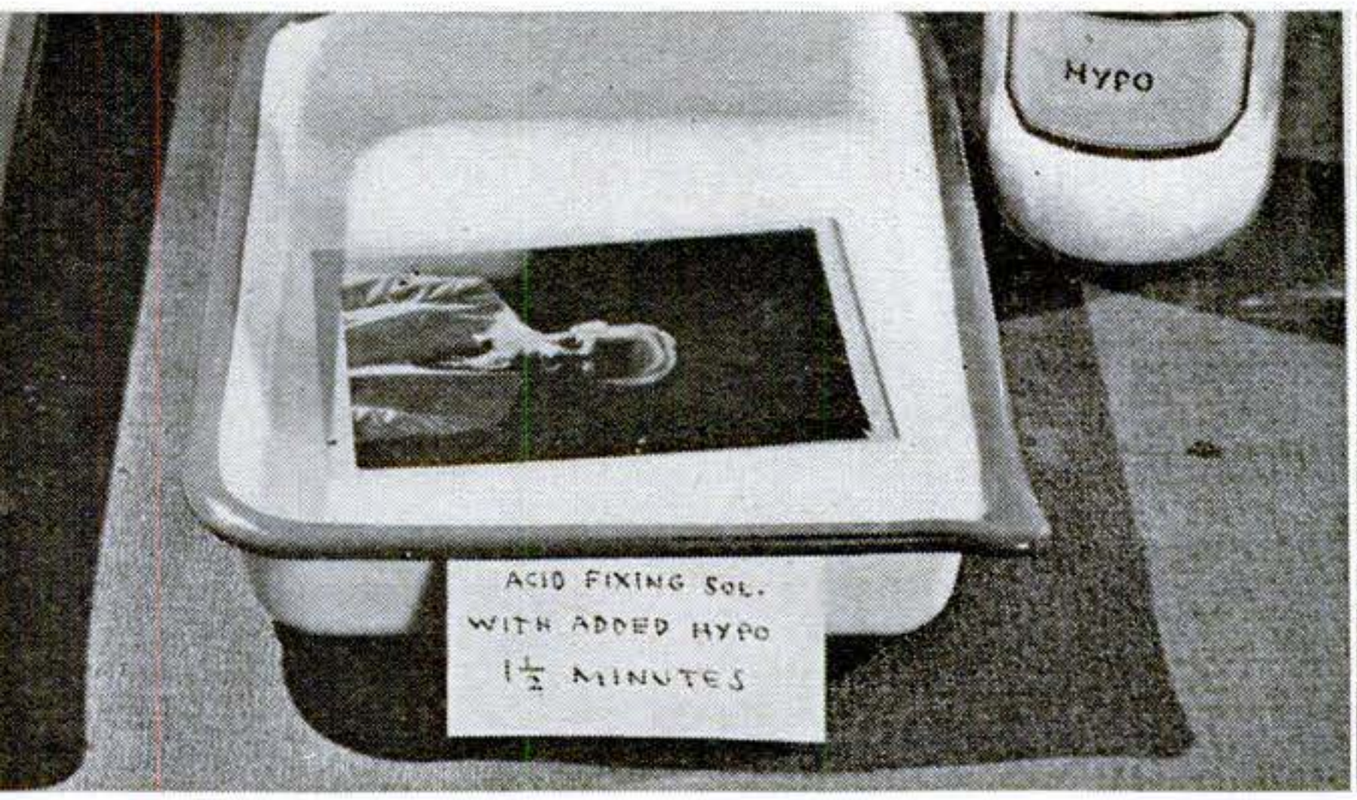
It will help, of course, to have all your equipment arranged and your solutions mixed, ready for work the second you hit the darkroom. Sheet film is most practical for rapid finishing, but there's no reason you can't get speed with roll film.

If you incline toward submitting news photos to your local newspaper, better find out first whether they'd rather have undeveloped film, negatives, contacts, or finished enlargements. Because of their superior facilities, certain of the larger papers would rather have the film.

Developers for rapid work can be either the single or two-solution variety. In a two-solution developer, the developing agents and preservative are in the first tray, the alkali in the second. Such developers have longer life and make it easier to control development. The first solution may be stored and reused repeatedly. The second should be renewed after becoming badly discolored.

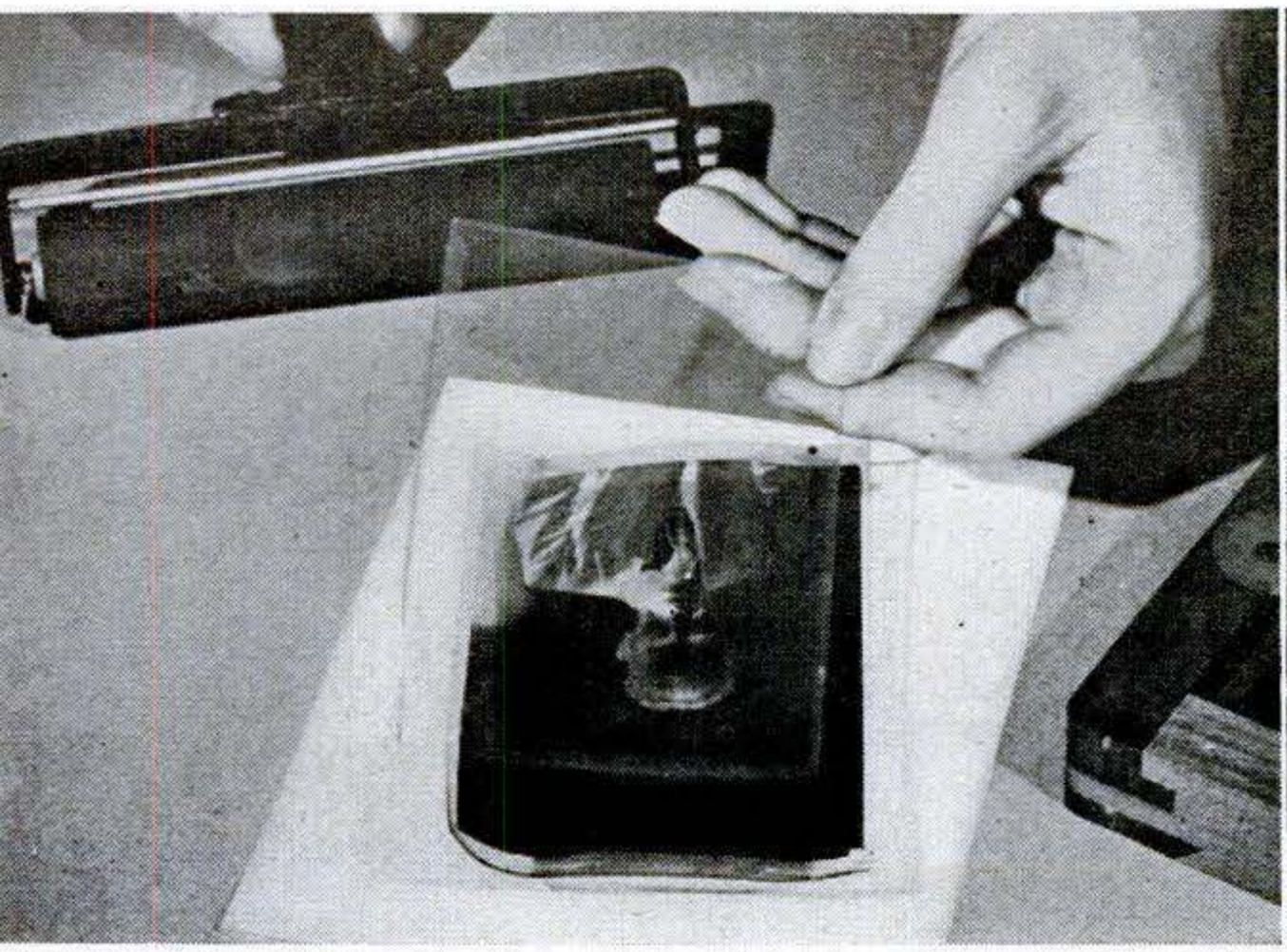
Ansco recommends this formula:

Solution 1—in 24 oz. water at 125° F., dissolve 75 grains metol, 1 oz. sodium sulphite, and ¼ oz., 35 grains hydroquinone; then add water to make 32 oz. Solution 2—

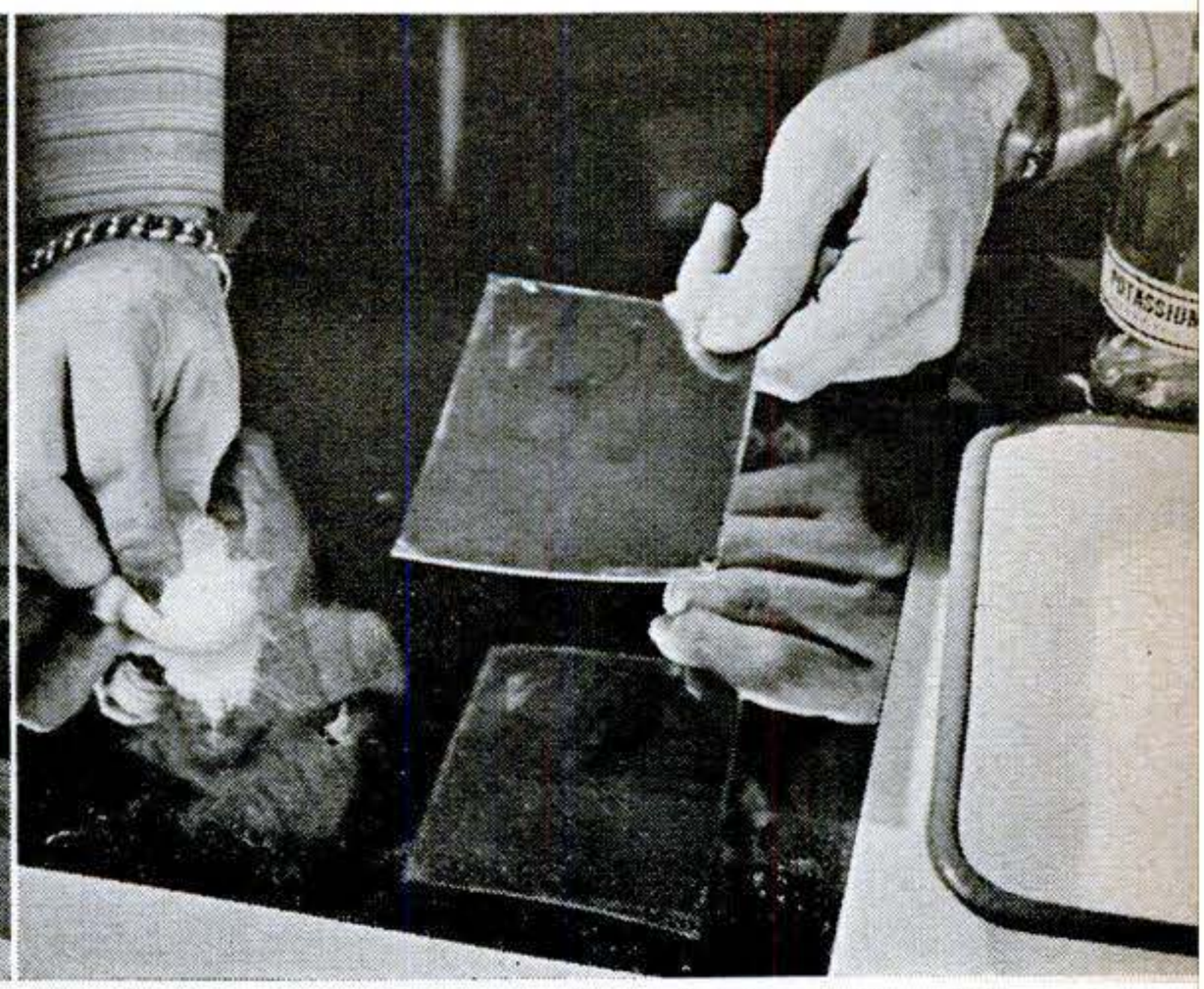


3. Add extra hypo to speed up fixing. About 4 oz. to each quart gives best results. Fix the neg for about 1½ min. with constant agitation.

4. Wash for 2 min. in rapidly running water. Later if you want to preserve neg, fix for 5 or 6 min. more and wash for about 20.



7. For contact printing, sandwich wet negative between two sheets of film from which emulsion has been cleared. Squeegee lightly.



8. A dry negative can be obtained by dehydrating it chemically in a saturated solution of potassium carbonate. Immerse it 4 or 5 min.

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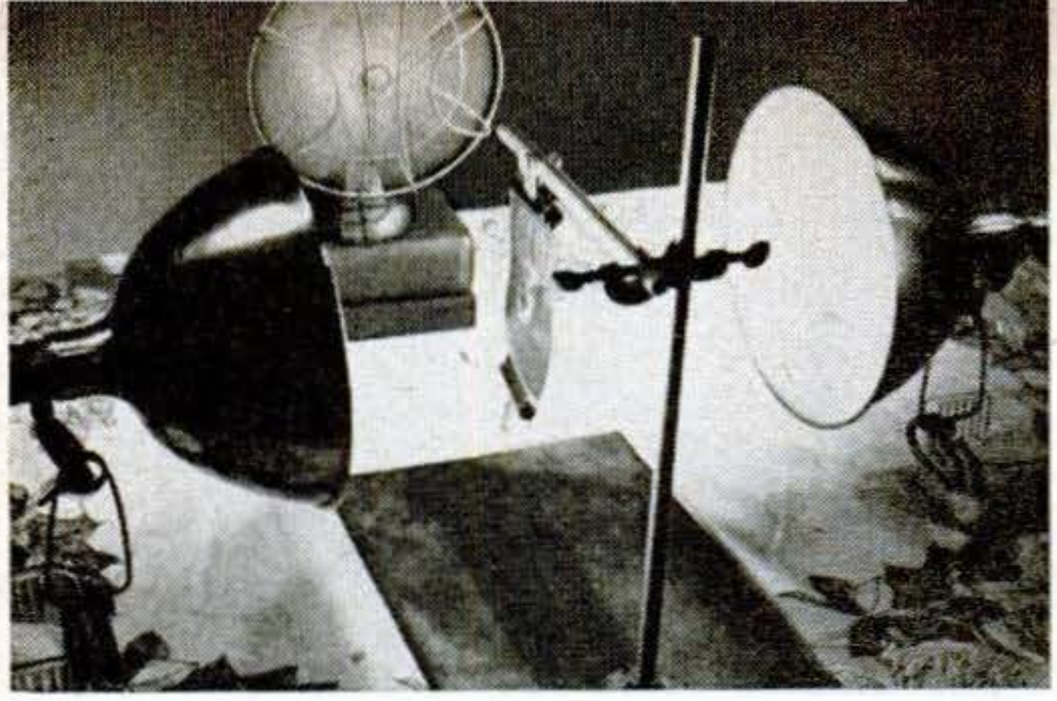
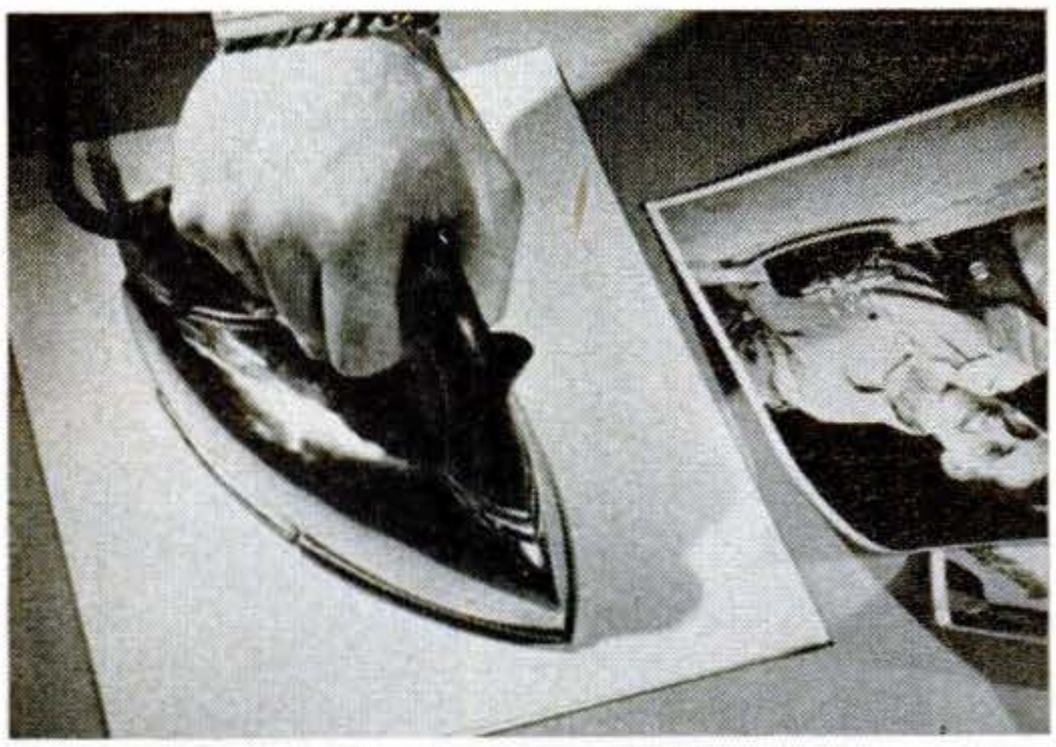


9. Infrared bulbs will also dry a neg quickly. Set them up as above and direct fan on neg to carry off moisture and prevent overheating.



10. Print can be dried quickly with a blotter and iron if an electric drier isn't available. Set iron at moderate heat and keep it moving.

in 24 oz. water at 125° F., dissolve 3½ oz. sodium carbonate. To use, pour each solution into a separate tray without diluting.

In rapid processing, submerge the film quickly and evenly. Agitate the tray constantly. At 70° F., immerse the neg 1 minute in the first solution and an equal time in the second, without rinsing between. At 75°, immerse in each solution 45 sec.

If you prefer a single solution, Kodak Dektol® or D-72 is excellent. Use as a stock solution without dilution. At 70° develop for 1 min., 40 sec; at 75°, 1 min., 20 sec.

After development, swish the film for 5 sec. in a short-stop bath made by dissolving 1½ oz. of 28-percent acetic acid in 32 oz. water. If the temperature of the solutions is above 70° dilute the short stop with an equal amount of water to prevent blisters.

To speed up the fixing, add 4 oz. plain hypo to each 32 oz. of the regular acid hardening fixing solution. After the film has been submerged for half a minute in this fixer, it's safe to turn on the light. Continue fixing until the negative has completely cleared. This should take about 1½ min.

Next wash for 2 min. in a tray through which water is running rapidly. Then place the negative on a clean ferrotype plate or sheet of glass and wipe off the surface.

You now have a choice of printing from the wet negative or drying it by rapid methods. The wet technique is faster.

For enlarging, place the wet neg in a glassless carrier or squeegee it lightly, emulsion side down, on a glass plate. For contact printing, wipe off the surface moisture and sandwich the negative between two sheets of film from which the emulsion has been cleared. Squeegee lightly to remove air bubbles. Handle all wet negs carefully, since the emulsion is soft and easily damaged. Keep exposure time to a minimum.

If you prefer a dry neg, you can dehydrate it chemically by immersing it in a saturated solution of potassium carbonate for 4 or 5 min. Make this solution by dissolving about 8 oz. potassium carbonate (salts of tartar) in 7 oz. warm water and allowing to cool.

After immersion, place the neg on a ferrotype plate and wipe the surface moisture from both sides. It will now be dry enough for printing. Wash it thoroughly later.

Two 250-watt infrared bulbs screwed into reflectors also provide a quick method of drying. Set the bulbs about 8″ on either side of the neg and direct an electric fan breeze along either side to prevent overheating. Always start the fan before turning on the bulbs, leaving it on until after the lights are out. Before trusting a valuable neg to this drying method, better try it first with an old one to determine the best distances.

Negatives to be dried by artificial heat should be chemically hardened between developing and fixing. You can make a good hardener by dissolving ½ oz. potassium chrome alum in 16 oz. water, adding ¾ oz. of 28-percent acetic acid, and then adding water to make 32 oz. Place the negative in this instead of the ordinary stop bath and agitate for 3 min.

Develop the prints for 1 min. in a Dektol or D-72 type of developer diluted 1 to 1. Rinse for 5 sec. in running water and fix for 1 min., with constant agitation, in a separate batch of fixer with increased hypo.

Wash for 2 min. in running water, blot off the surface water, and dry on an electric drier or put between blotters and dry with an electric iron. In using an electric drier, put blotters between the print and drier apron to keep hypo from contaminating the apron. Prints that you want to keep for any length of time should be fixed several additional minutes and washed at least 30. END

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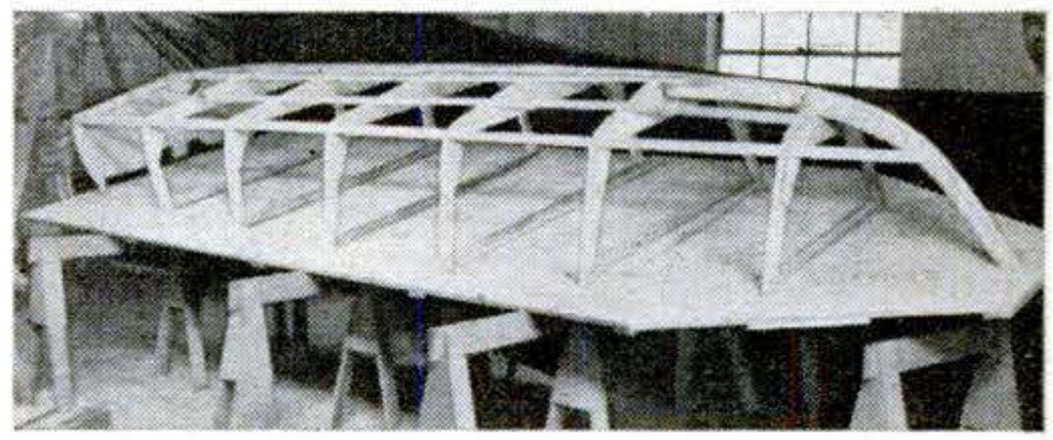
Boat Kits Designed for Home Assembly

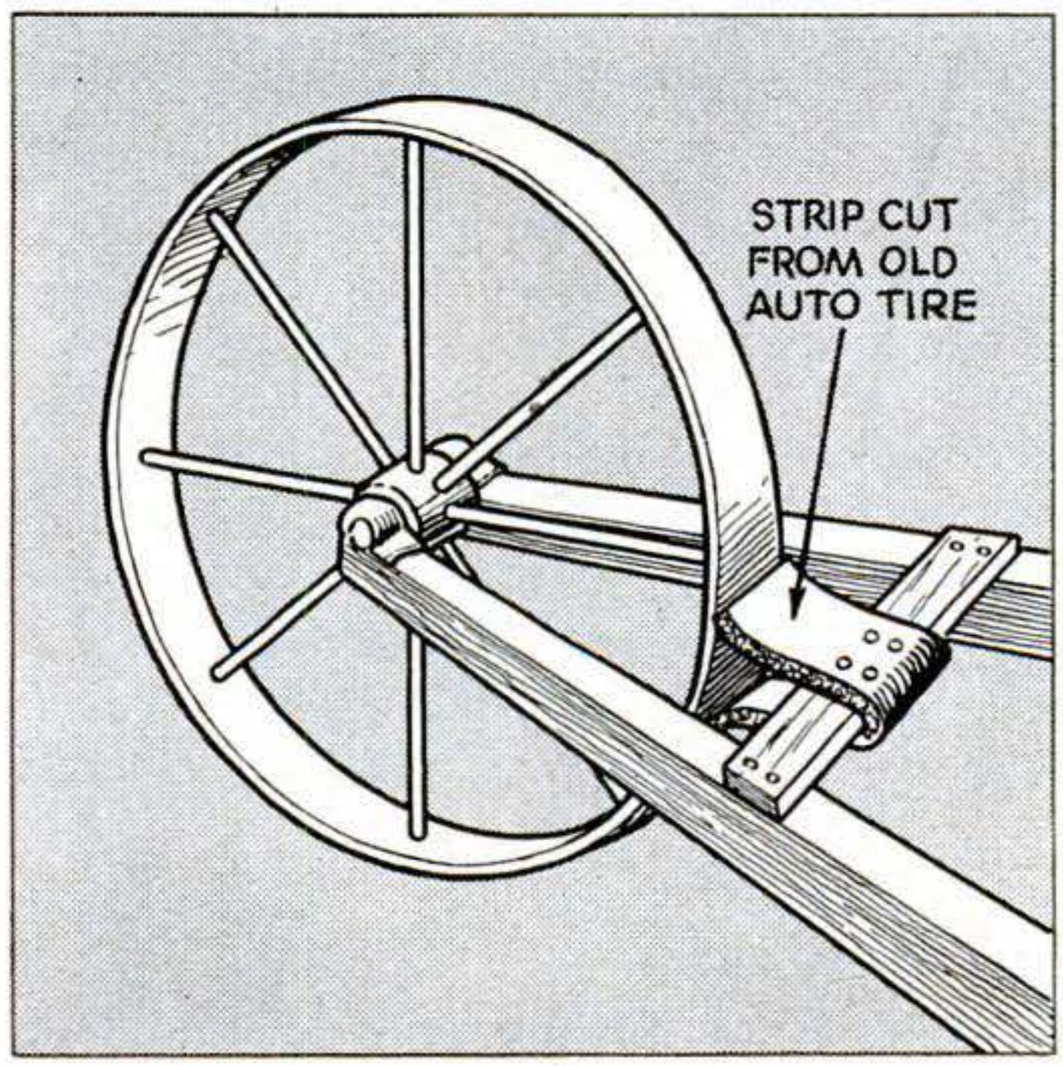
KITS of prefabricated boat parts—for craft ranging from an 8′ dinghy to a 23′ cabin cruiser—are offered by U-Mak-It Products, Marine Division, of New York City. Each package includes necessary screws, bolts, glue, seam compound, and basic fittings, but no ornamental hardware.

All the plywood and hardwood parts are lettered and numbered for easy assembly. Each kit includes a set of step-by-step photos that show the various stages of construction. Frames and transoms come already assembled. Curved parts are supplied steamed and bent, ready to install. All rowboat plankings are cut for the full length of the boat. Transoms are of five-ply ¾″ marine



plywood and reinforced all around with hardwood.

The company also offers a line of accessories and parts such as deck fittings, propellers, shafts, and rudders as well as marine conversion parts for several automobile engines. Prices for boat kits range from $47.50 for the dinghy to $973 for the cruiser.



Rubber Clears Wheel of Mud

A STRIP cut from an old automobile tire and attached to a wheelbarrow as shown will keep the wheel free of mud. The thick rubberized cord makes a satisfactory scraper, since it is too flexible to lock the wheel.—*Edward H. Stutz, Cleveland, O.*

Plug Drains Garden Sprayer

MANY garden sprayers are ruined by rusting through the bottom because it's almost impossible to remove all the liquid after use. I altered my sprayer by fitting a drain plug in the bottom. To do this, drill a 7/16″ hole in the center. Tap a brass or galvanized washer for a ⅛″ pipe plug and solder the washer over the hole. Use a brass or galvanized plug that has a shoulder to hold a rubber washer. The plug usually will hold pressure when only finger tight.—*Clinton R. Hull, Costa Mesa, Calif.*

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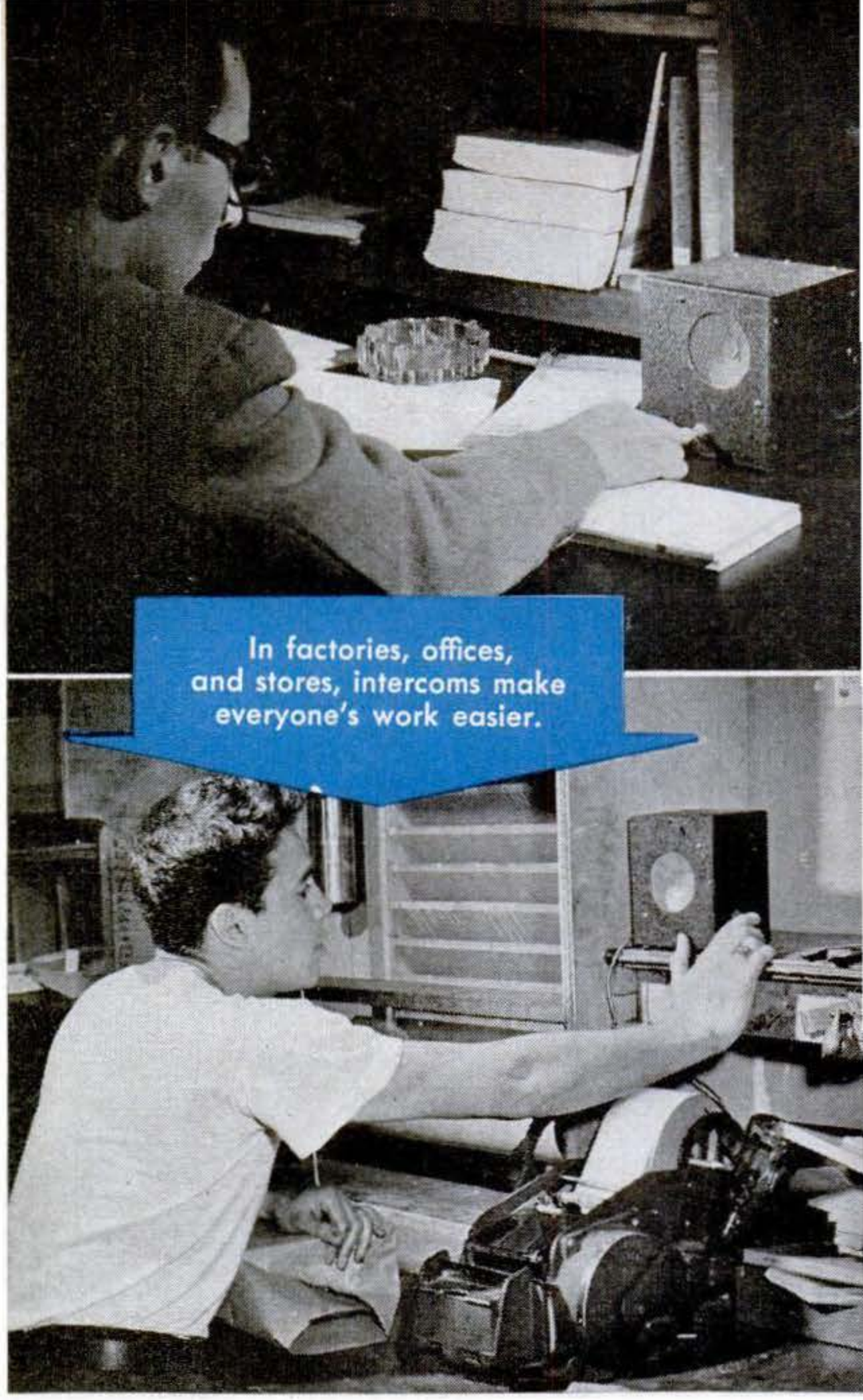
Intercoms Save You Steps in Home, Office, Shop

Take your pick of a minimum tubeless circuit, an instant-heating battery job, or a heavy-duty AC-DC unit.



IF YOU live or work in more than a couple of rooms, the question you may well ask yourself is not *whether* you need an intercom but *what kind* of intercom you need. These tireless servants run your errands faithfully to save you countless steps. At home they make it unnecessary to shout from cellar to attic; at work they lighten the load on telephone extensions and get your message through fast.

But granting their usefulness, it must still be admitted that no one type of intercom is suited to every job. If you have to make only one or two calls a day, you wouldn't want a set that draws current while it's idle. A battery set will give you the advantages of instant heating, and uses no stand-by power. On the other hand the cost of battery replacements may make it unwise to use this type of circuit when the intercom must be left on for long periods.

To solve a variety of intercom problems, POPULAR SCIENCE has rounded up the three pairs of squawk boxes pictured above and on the following pages. The first, built by Tracy Diers, of Richmond Hill, N. Y., is a three-tube, battery-powered unit. It requires no warm-up period, so calls can be made instantly from either end. Because no current is used unless a call is being made, the batteries will have long life.

The second pair, devised by William Norton, Manhattan, N. Y., consists of two identical units. It would be hard to find a simpler circuit, for each box contains only a war-surplus carbon mike, a speaker, and a battery. No tubes are used.

Henry C. Martin, also of Manhattan, built the third set. It operates from an AC or DC house line and is ideal for service in which it will be turned on in the morning and off at night. After it has warmed up, calls can be made from either end just by pressing a button. In the photo at the right, above, the remote unit is shown in service as a baby tender. The master set in the shop enables

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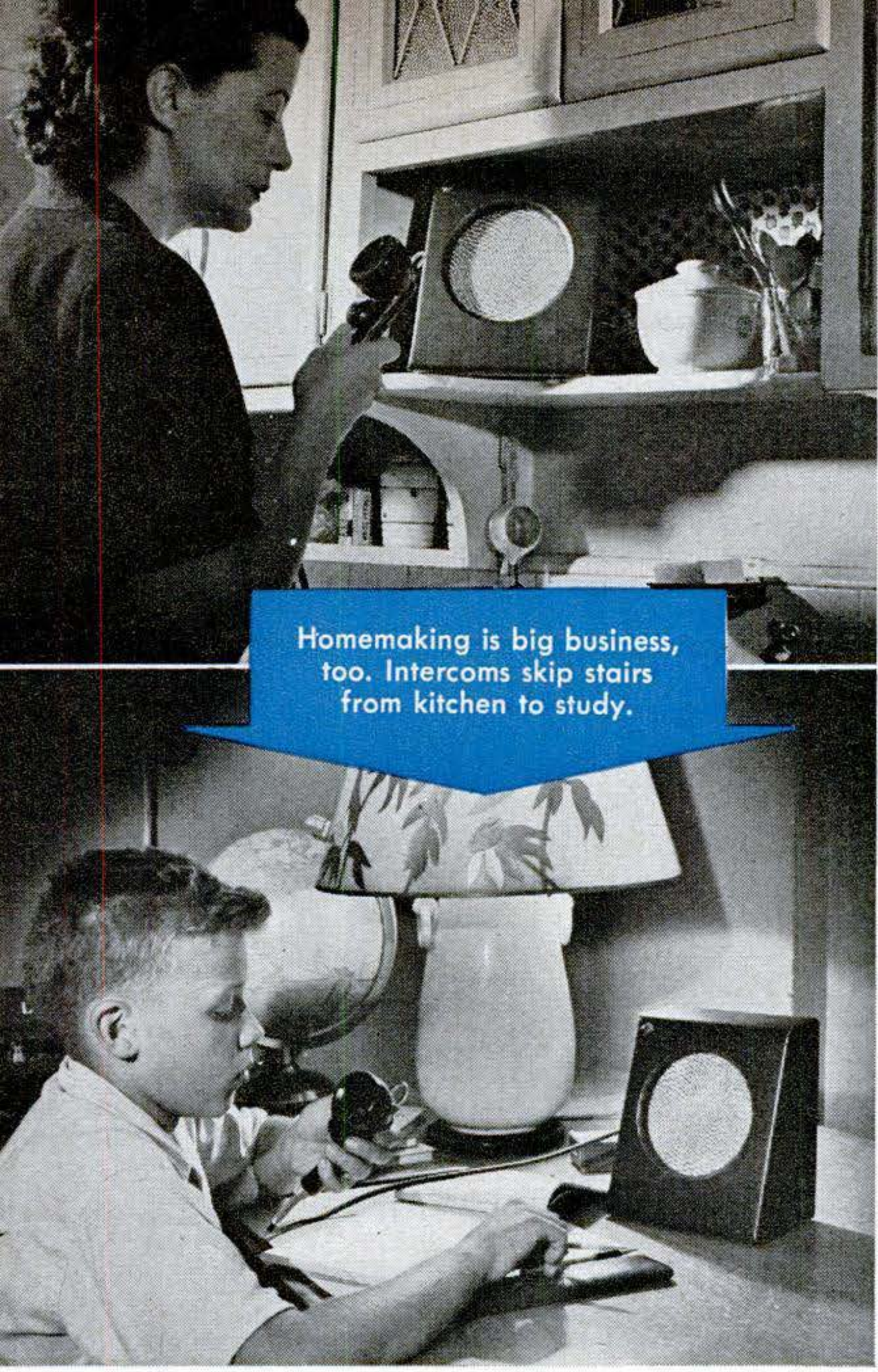
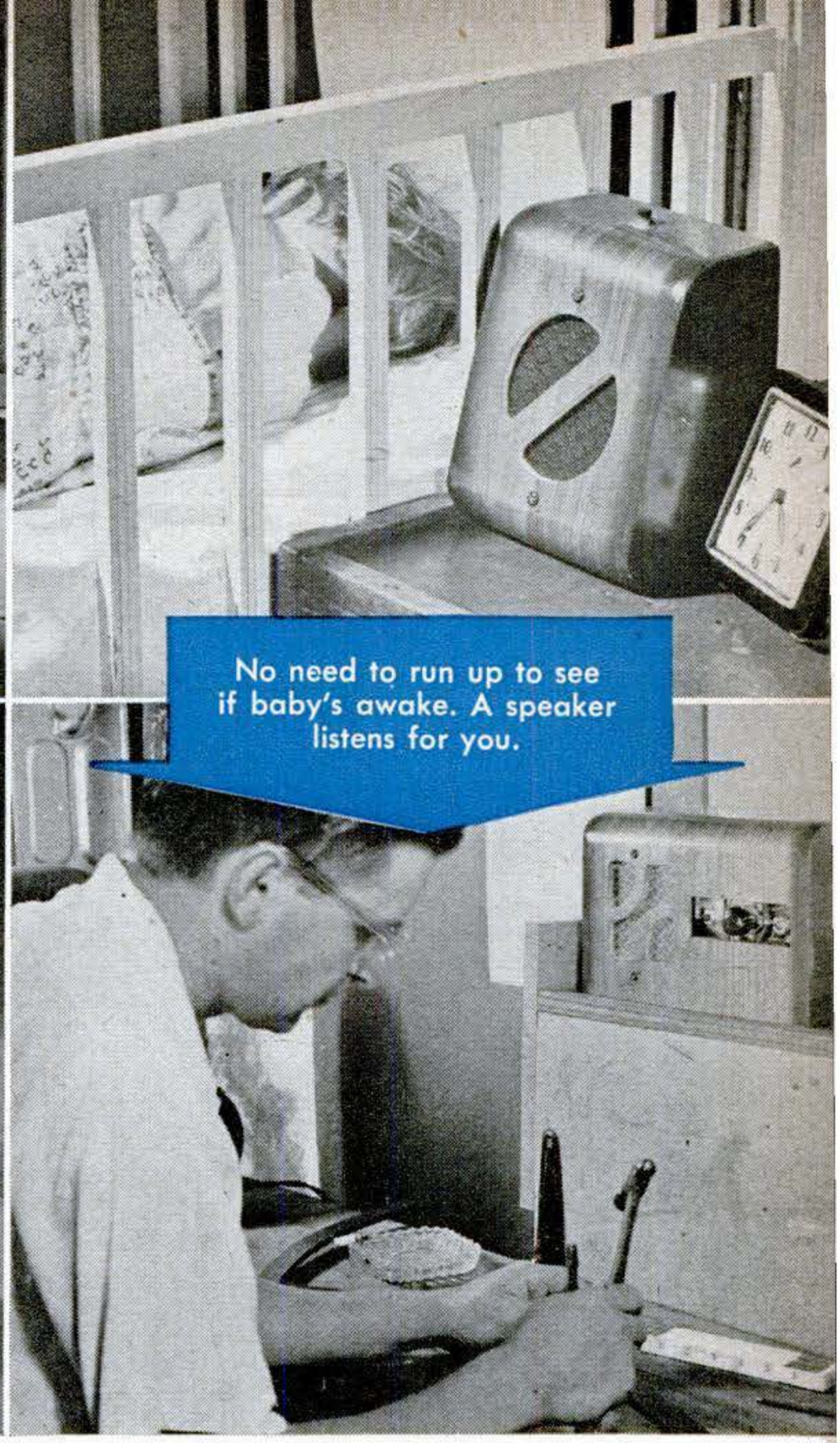


Homemaking is big business, too. Intercoms skip stairs from kitchen to study.



No need to run up to see if baby's awake. A speaker listens for you.

you to keep tabs on a sleeping child upstairs. Note the clock placed next to the listening box. So long as its ticking can be heard downstairs, you know the intercom is functioning.

Battery-operated Intercom

In the three-tube circuit shown in photos and diagram on the following page, two small permanent-magnet speakers double as microphones. Power is obtained from a 67½-volt B battery and a 1½-volt hearing-aid cell.

Build the amplifier first. The model pictured was assembled on a 3¾″ by 4½″ chassis. Three tubes and two transformers are mounted on top of the chassis, as can be seen in the photos. An 8-contact terminal strip is also placed on top to facilitate connections to batteries and the remote unit.

The amplifier should present no special wiring problems. Short leads are always desirable; all of these were made with push-back wire. Ground connections are soldered to lugs bolted to the chassis. Use solder sparingly; a blob of it could easily short-circuit the closely spaced prongs of the miniature tube sockets.

When you have completed the wiring, you can test the amplifier by connecting the voice-coil terminals of the remote speaker to terminals 3 and 4. Press S1 down to turn on the filaments. The amplifier should start operating immediately. Since the speakers are close together in this test, you will probably also hear a loud feedback howl. Moving the speakers farther apart reduces it.

Both the local and remote units were placed in metal boxes. The former measures 5½″ by 5½″ by 6⅛″, and has two removable covers. The back cover was discarded and a piece of wire screening was fastened in its place. The front panel is then drilled to clear the shafts of S1 and R7, and a speaker hole is cut out.

The remote box is simplicity itself. It contains only speaker, switch, and a four-

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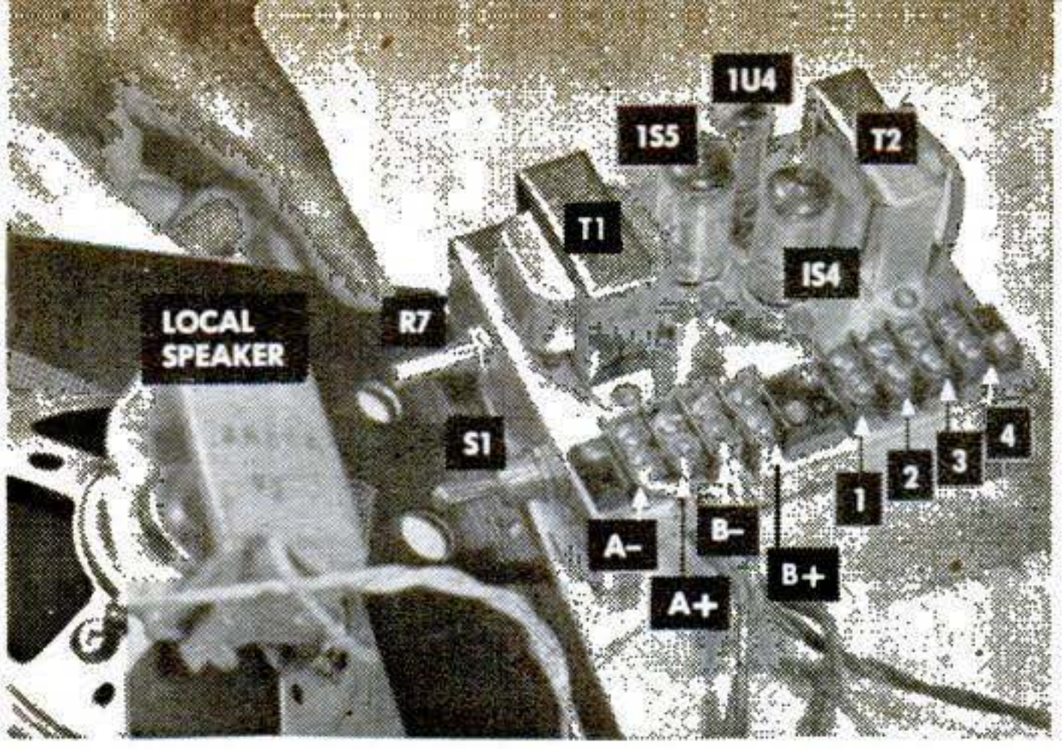
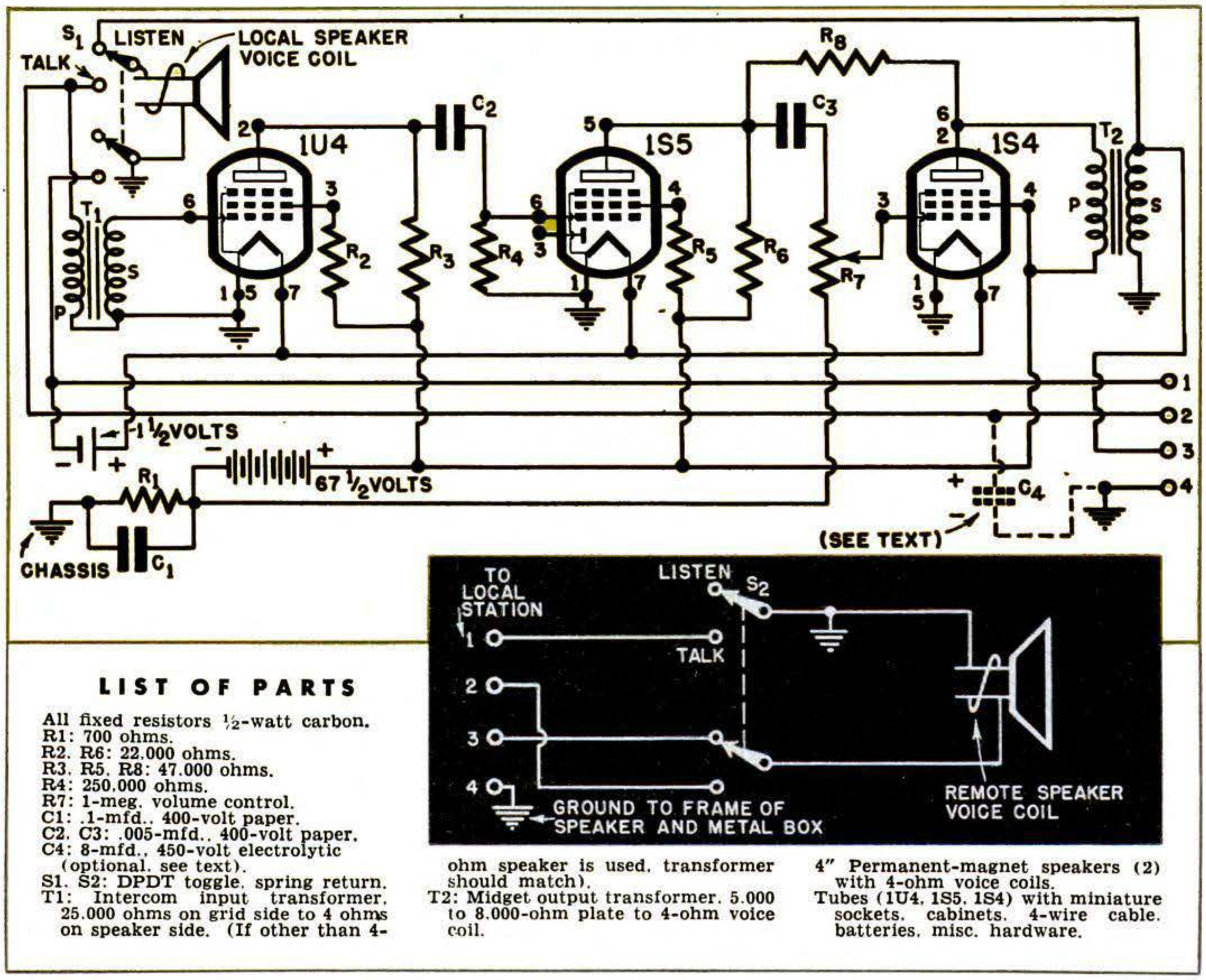


Local station is assembled on a 3¾" by 4½" chassis; transformers, tubes, and terminal strips go on top. Controls are on front edge.

Front panel of metal box is cut for speaker and control shafts; the back cover is removed and replaced with a piece of wire screening.

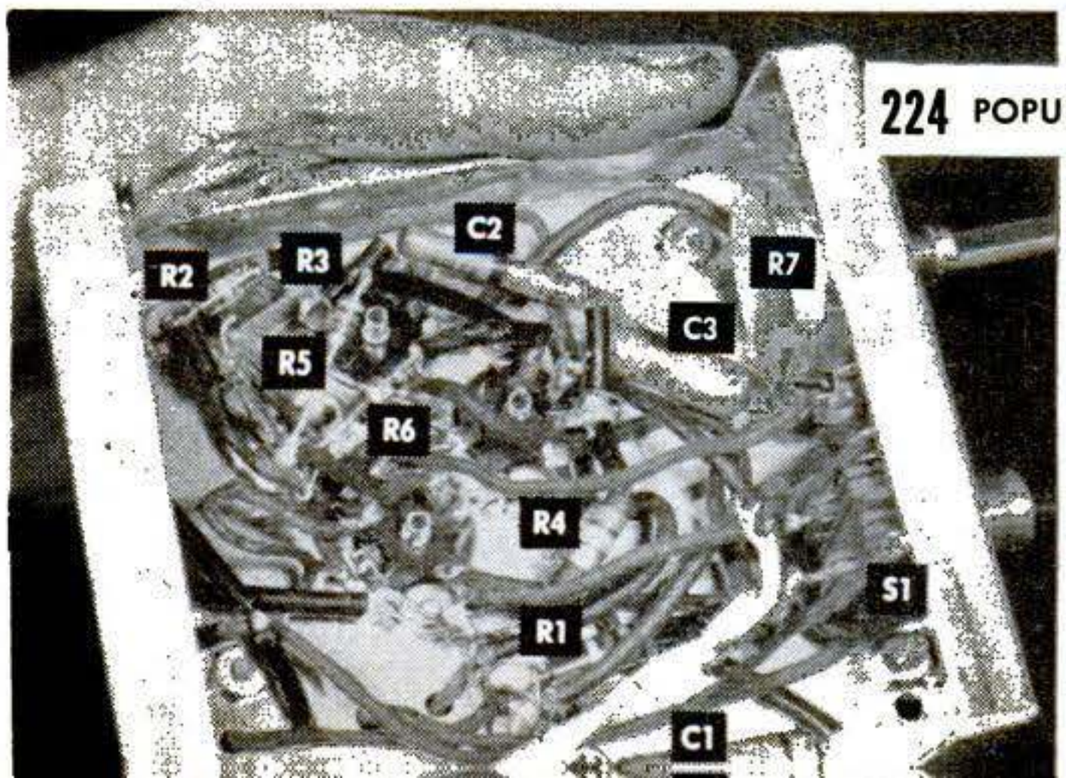


LIST OF PARTS

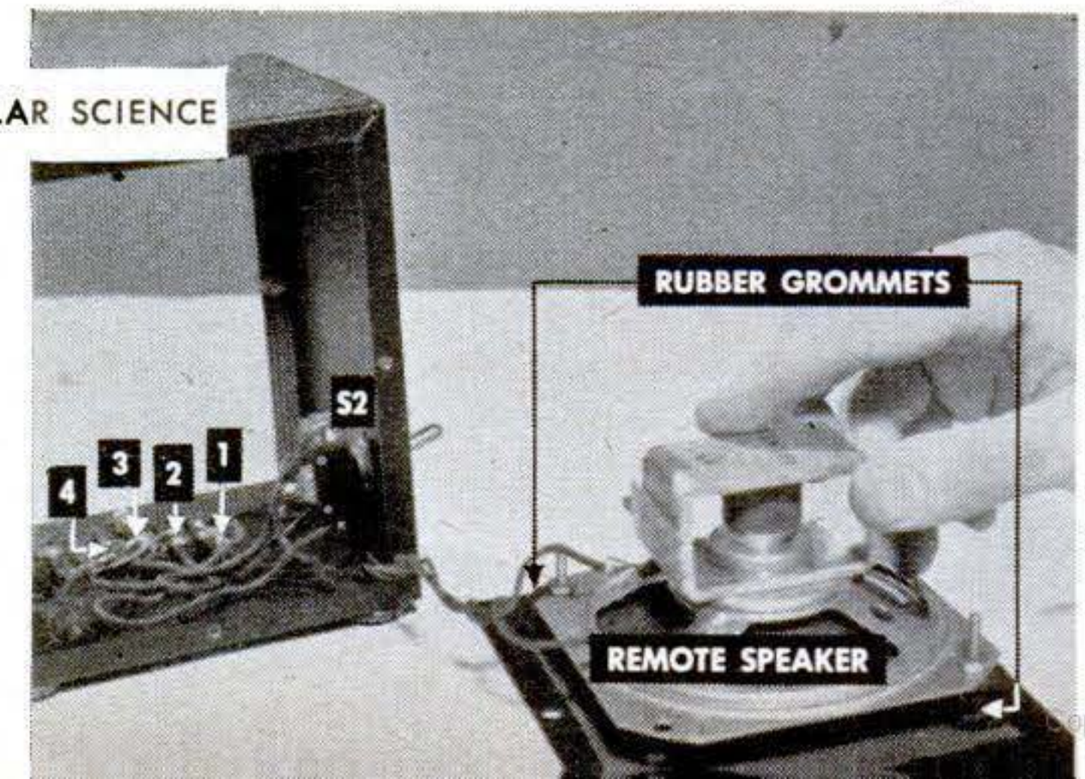
All fixed resistors ½-watt carbon.
R1: 700 ohms.
R2, R6: 22,000 ohms.
R3, R5, R8: 47,000 ohms.
R4: 250,000 ohms.
R7: 1-meg. volume control.
C1: .1-mfd., 400-volt paper.
C2, C3: .005-mfd., 400-volt paper.
C4: 8-mfd., 450-volt electrolytic (optional, see text).
S1, S2: DPDT toggle, spring return.
T1: Intercom input transformer, 25,000 ohms on grid side to 4 ohms on speaker side. (If other than 4-ohm speaker is used, transformer should match).
T2: Midget output transformer, 5,000 to 8,000-ohm plate to 4-ohm voice coil.
4" Permanent-magnet speakers (2) with 4-ohm voice coils.
Tubes (1U4, 1S5, 1S4) with miniature sockets, cabinets, 4-wire cable, batteries, misc. hardware.

When planning parts layout leave space for batteries; they go in cabinet with amplifier.

Bottom view shows location of most of the small parts. Position isn't critical in this circuit but it's good to keep leads short.



Remote station contains speaker and switch. Grommet mounting of speaker helps reduce bass tone that often occurs at the end of a long line.



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contact terminal strip housed in a 4″ by 5″ by 6″ metal box. Stack a couple of rubber grommets or washers on the screws that hold the speaker to space it back of the panel.

Connections between the two units are best made with four-conductor intercom cable, but you can use two lengths of lamp cord. The latter, however, may cause some oscillation. Should this happen, add an 8-mfd. electrolytic condenser (C4) from terminal 2 to ground on the local unit. It's essential, of course, to connect the local-station terminals to the corresponding ones on the remote unit. With four-wire cable, the job is made easy by color-coded wires; if you use uncoded lamp cord, test each lead for continuity.

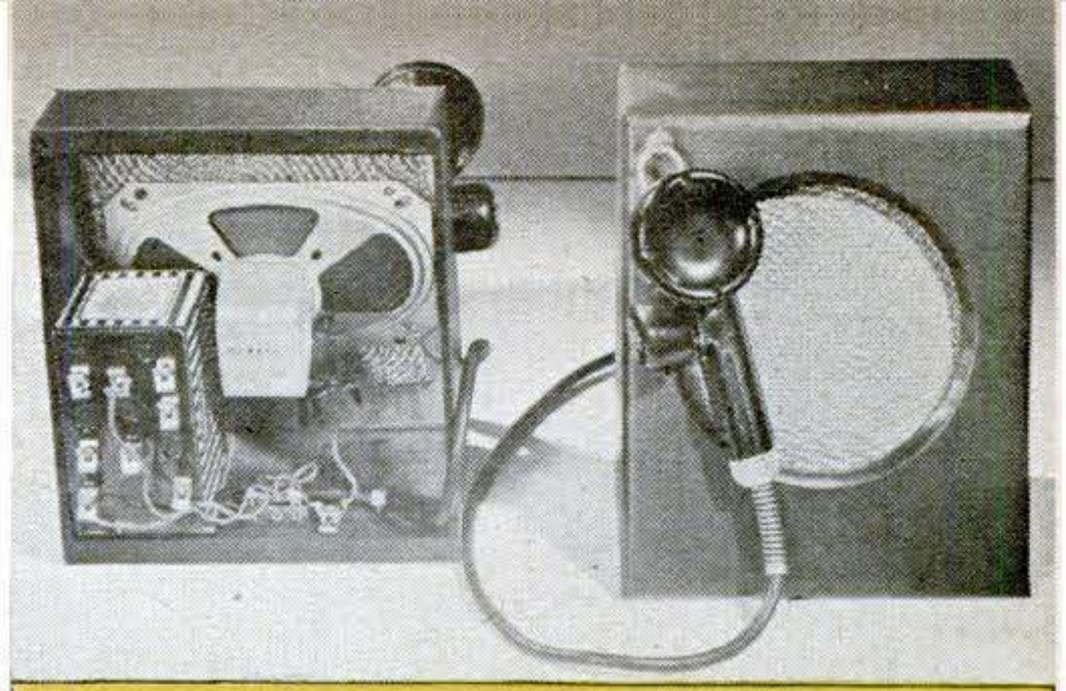
Tubeless Intercom

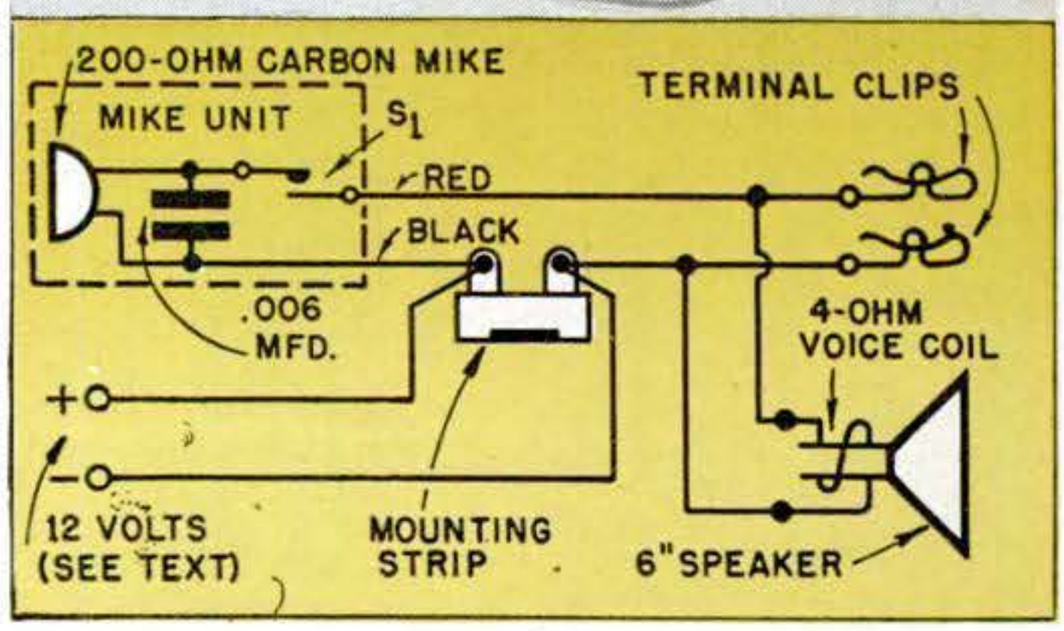
There are many cases, especially around the home, where an intercom would come in handy, yet the use you can get out of it doesn't justify the cost or work involved in building a high-powered job. For such light service, take a crack at the tubeless unit pictured above. It will work at distances from 50 to 100 feet. Though it isn't loud, it is clear and audible.

Two Army-surplus T-17B microphones were purchased for about a dollar apiece; each of the 6″ speakers cost just a bit more than that. These items plus a pair of batteries are all you need. If you make your own cabinets, total cost won't go much above $3 a unit. Should you have trouble obtaining the surplus mikes, use standard carbon microphones. In this case, however, reduce battery voltage to 6 to 8 volts. The army mikes have three color-coded leads. Use only the black and red ones; cut off the white. This takes advantage of the press-to-talk switches in the mikes; no other switches are needed. Connect the units together with two-conductor wire attached to the terminal clips indicated in the diagram.

AC-DC Unit

An amplifier circuit similar to that used in small record players provides the muscle for this two-tube squawk box. Special coupling transformers and a switching arrangement again allow ordinary permanent-magnet speakers to double as microphones. The speaker-to-grid matching transformer, T1, couples the Alnico® speakers to the input of the amplifier. Primary impedance matches that of the voice coils (in this case, 4 ohms). Secondary impedance should be as high as possible. In the unit shown it is 106,000 ohms.





Simple intercom needs only mike, speaker, and battery. Parts enclosed in dotted line in diagram are included in surplus T-17B mike.

The other transformer, T2, matches the output of the 50B5 (about 2,000 to 2,500 ohms) to the speaker voice coils. Note the tap on the primary; this is a hum-reduction tap. Although it isn't essential, it will improve the performance of the circuit. If you use a transformer without this tap, connect the points marked X together.

Parts are mounted on a 1½″ by 4½″ by 5″ metal chassis and on a clear plastic panel bolted to the chassis front. The controls that go on the panel are the on-off switch, S1, the 250,000-ohm volume control, R2, and the press-to-talk switch, S2. A 3-contact strip is mounted on the rear chassis edge.

After mounting the parts—preferably in the approximate locations indicated in the photos—proceed with the wiring. First make connections to the secondary of T2 and the primary of T1, then wire S1 and the terminal strip. Now follow the wiring diagram, reading from left to right. Leave the rectifier circuit to the last. When you get to it, be sure that both leads are connected to the rectifier before wiring C6 on top of it.

Three-conductor cable wires the master and remote units together. Connections from one terminal strip must be made to the corresponding numbers on the other.

Once you have an intercom installed, you'll find many extra uses for it. It's possible, for example, to pipe music from room to room by placing the master

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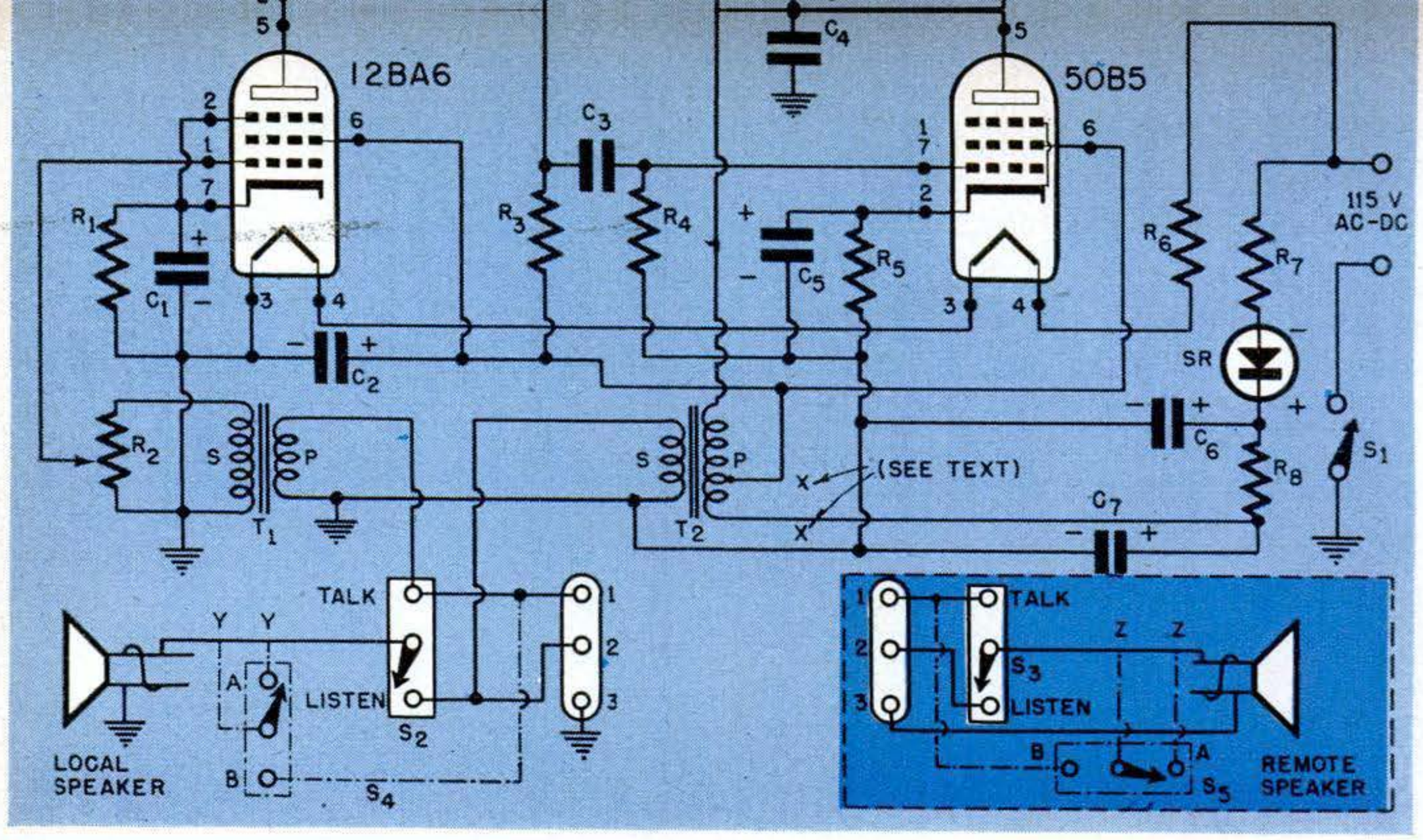
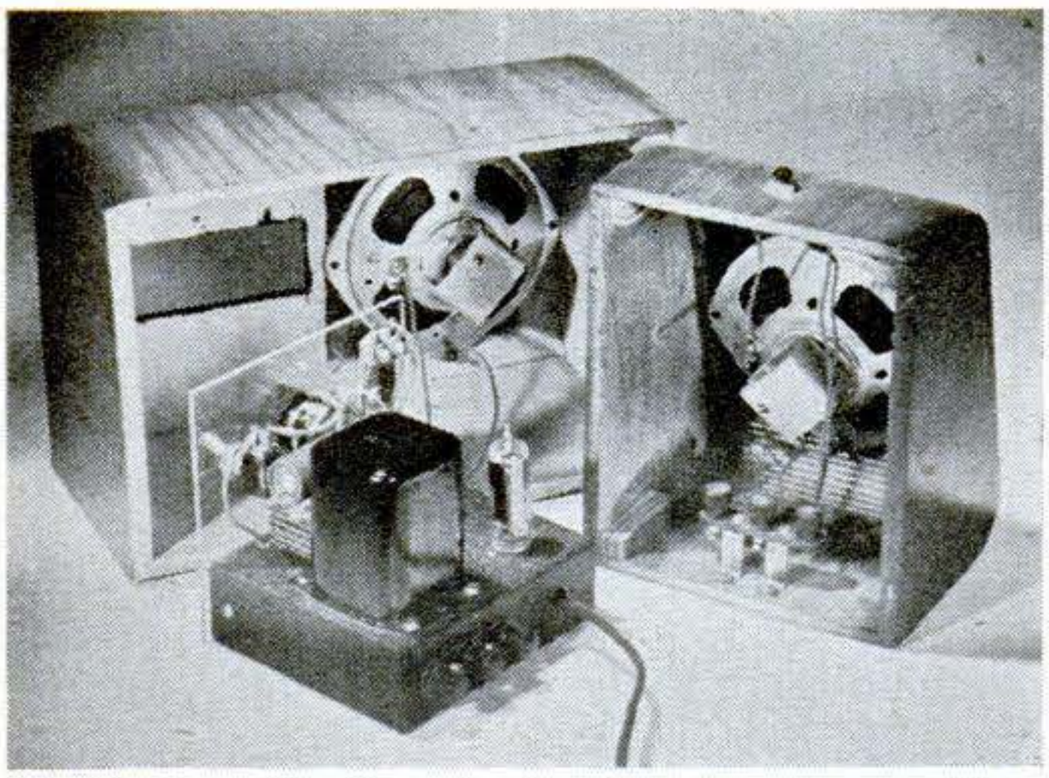


LIST OF PARTS

R1: 33,000-ohm, ½-watt carbon.
R2: 250,000-ohm volume control.
R3: 180,000-ohm, ½-watt carbon.
R4: 680,000-ohm, ½-watt carbon.
R5: 200-ohm, 1-watt carbon.
R6: 390-ohm line-cord resistor.
R7: 68-ohm, 1-watt carbon.
R8: 1,000-ohm, 5-watt wire-wound.
C1: 1-mfd., 150-volt electrolytic.
C2: 4-mfd., 150-volt electrolytic.
C3: .05-mfd., 400-volt paper.
C4: .001-mfd., 600-volt paper.
C5: 8-mfd., 150-volt electrolytic.
C6: 40-mfd., 150-volt electrolytic.
C7: 50-mfd., 150-volt electrolytic.
S1: SPST toggle.
S2, S3: SPDT spring-return switches.
S4, S5: SPDT (optional).
T1: Intercom input trans., 106,000-ohm grid to 4-ohm speaker.
T2: Output trans. for 50B5; 2,000-ohm plate to 4-ohm voice coil.
SR: 100-ma. selenium rectifier.
5" Permanent-magnet speakers (2) with 4-ohm voice coils. (If other than 4-ohm speakers are used, transformers should match.)
Tubes (12BA6, 50B5), miniature sockets, cabinets, 3-wire cable, misc. hardware.

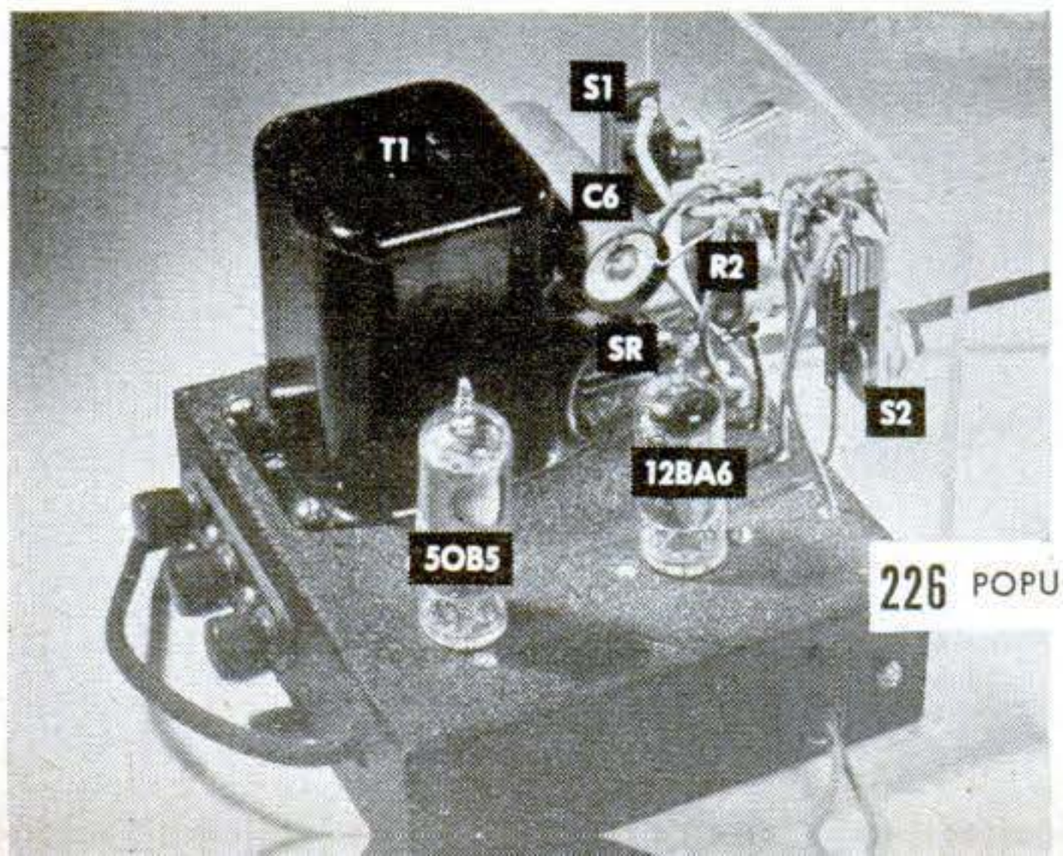


AC-DC unit uses speaker and two-tube amplifier in master or local station. Remote box, right, contains only speaker and switch.

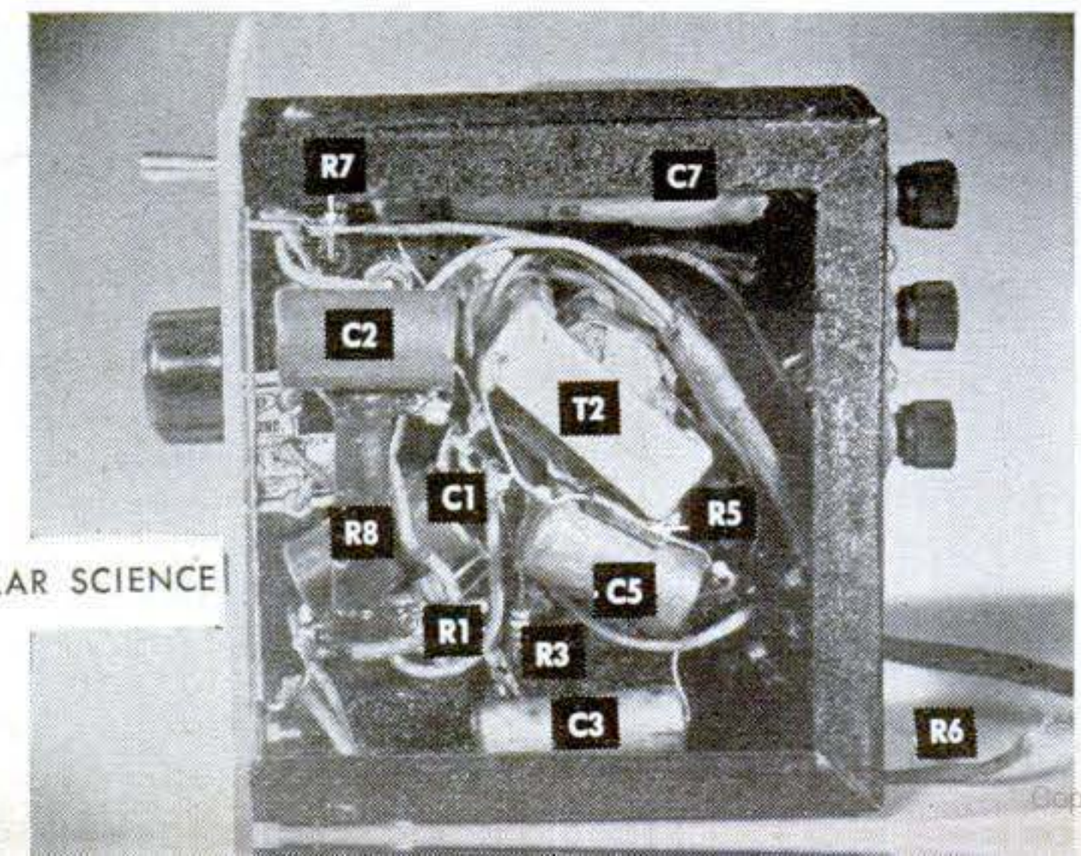
unit in front of the radio. Since S2 is a spring-action switch and normally in the "listen" position, you either have to replace it with an ordinary SPDT switch, or, better still, add S4. Break the original connection at the points marked Y-Y and wire in the new switch. When S4 is in position *a*, intercom operation remains unchanged; when it's flipped to *b*, the master unit is locked in "talk" position.

The same considerations apply to the remote unit. Adding S5—and breaking the original lead at Z-Z—readies the small box to act as a baby tender. Place it next to the baby's crib and if the youngster cries, you can hear it at the master unit. END

Clear plastic front panel is attached directly to amplifier. No pilot light is needed since plastic window shows when tubes are lit.



The output transformer was placed under the chassis in this set. If you use a shallow chassis, it can be moved to the top.



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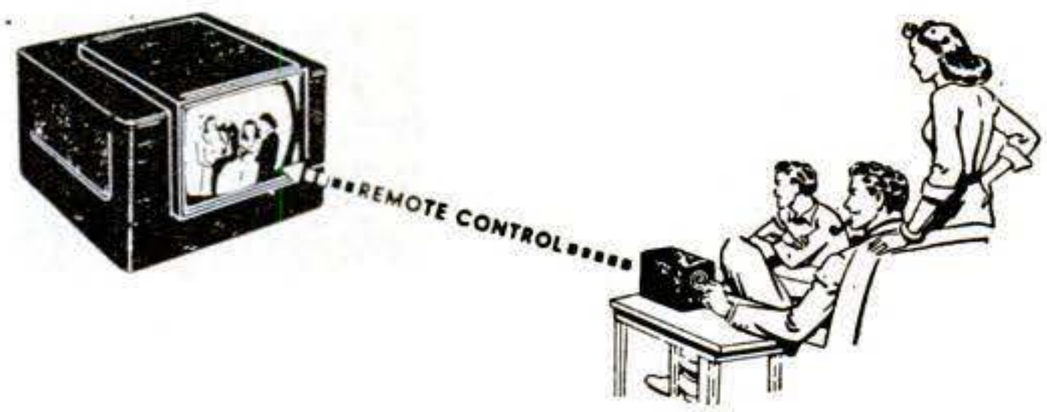
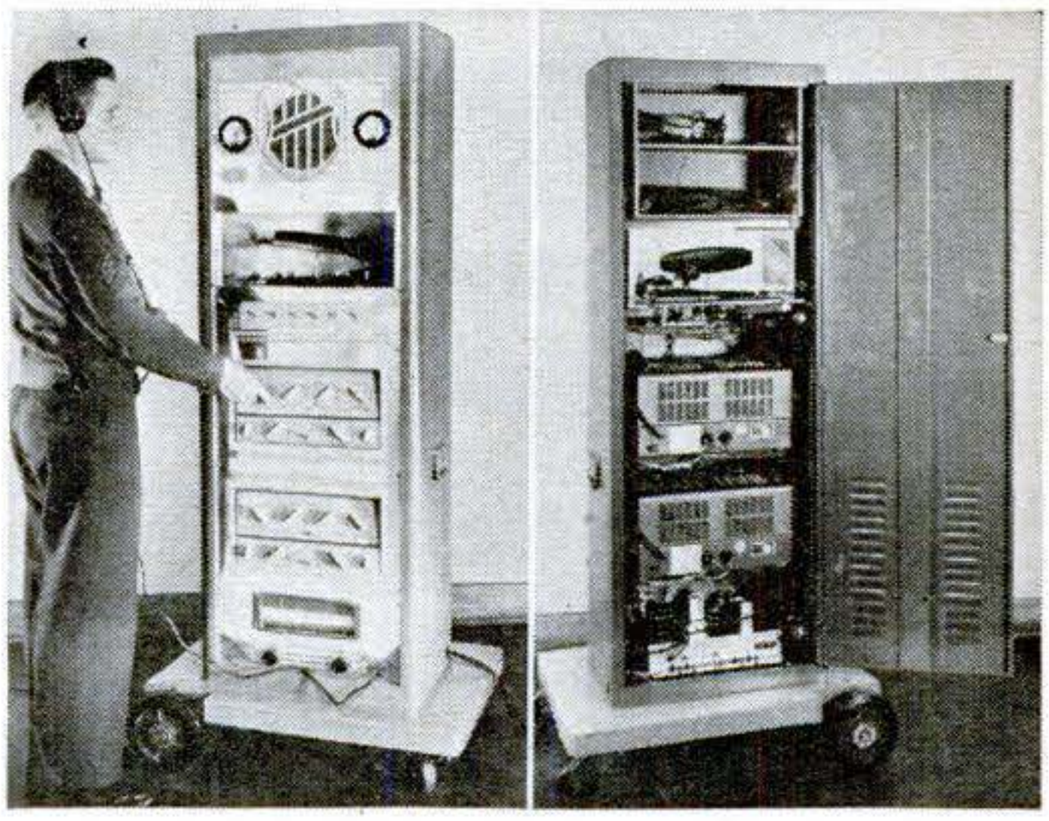


Unit Modernizes Old TV Sets. If you have an early TV receiver that tunes to only 3 or 5 channels, this remote control unit will help bring it up to date. Designed for use with any type of receiver, the unit provides tuning on all channels. It turns the set on and off, tunes in stations, and controls contrast and brightness from positions up to 50′ away. It's especially good for projection sets, best tuned from a distance.

Made by Transvision, Inc., New Rochelle, N. Y., the unit sells in a walnut cabinet for about $69—or $4 less without the cabinet. A 25′ cable is included.

Single Antenna Serves 24 Sets. Here's a unit that makes it unnecessary for television or FM antennas to sprout all over the roof of an apartment building. Called a Telecoupler®, one unit enables up to eight receivers to use a single antenna; or as many as three units can be connected in cascade to one antenna lead, raising the receiver total to 24 without interaction between sets. Television Equipment Corp., New York, makes the unit.

Child Can Hear Own Records. A magnetic recorder for children introduced by GE uses an 8″ paper disk coated with "powered" iron. Disks revolve at 20 r.p.m. and hold about two minutes of recording. Records can be erased with a small magnet. A 3½″ loudspeaker doubles as the microphone. Nursery scenes decorate the case.



PA System Rolls on Dolly. Signal Corps technicians at Fifth Army headquarters in Chicago have combined a public-address system, phonograph, and AM radio into one compact unit for portable use. All elements are housed in a cabinet set securely on a dolly.

Front and rear views are seen above. Two amplifiers are included, one being an emergency spare. The record changer operates at either 33⅓ or 78 r.p.m. A lead from one electrical outlet feeds all elements.

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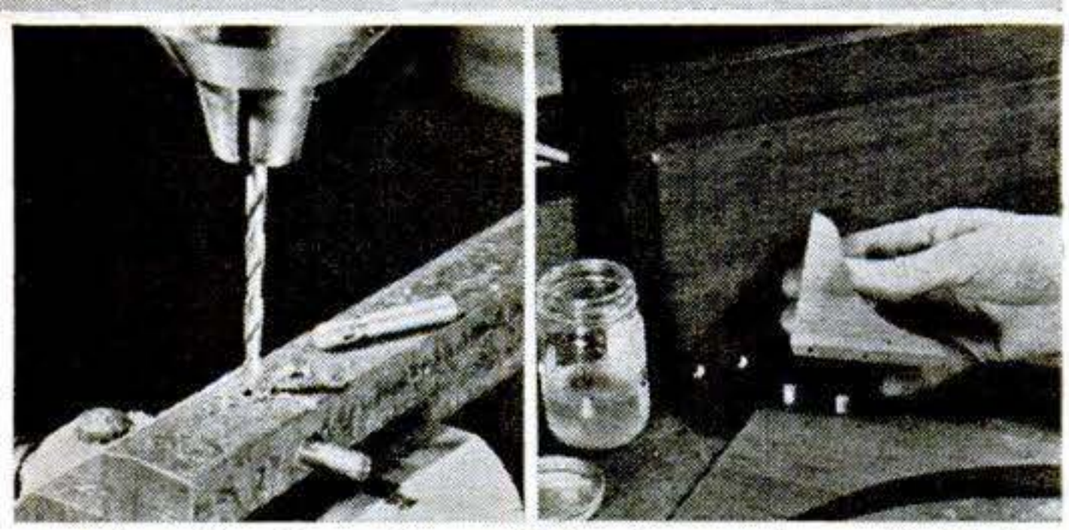
Brass-Railed Clock Shelf

A HANDSOME mantel clock deserves a handsome mantel. If you have the clock and not the mantel, this brass-railed shelf offers a happy substitute.

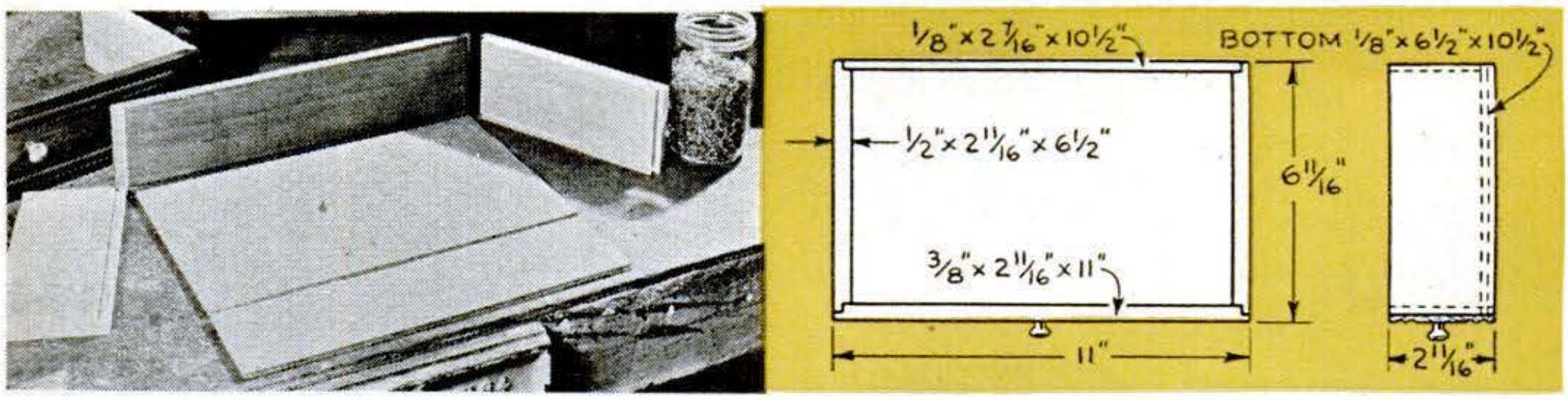
Select stock to harmonize with the clock case—mahogany, black walnut, or other cabinet wood. Black walnut was the choice for the shelf shown. Except for the ⅜″ drawer fronts, this is all 9/16″ stock. Hidden surfaces can all be plywood.

In assembling the 7″ by 24″ top and bottom shelf pieces to the sides, allow a ⅛″ overhang at the ends. Stop-rabbet the rear edges of these four pieces to receive the back panel. Assemble with glue and large brads.

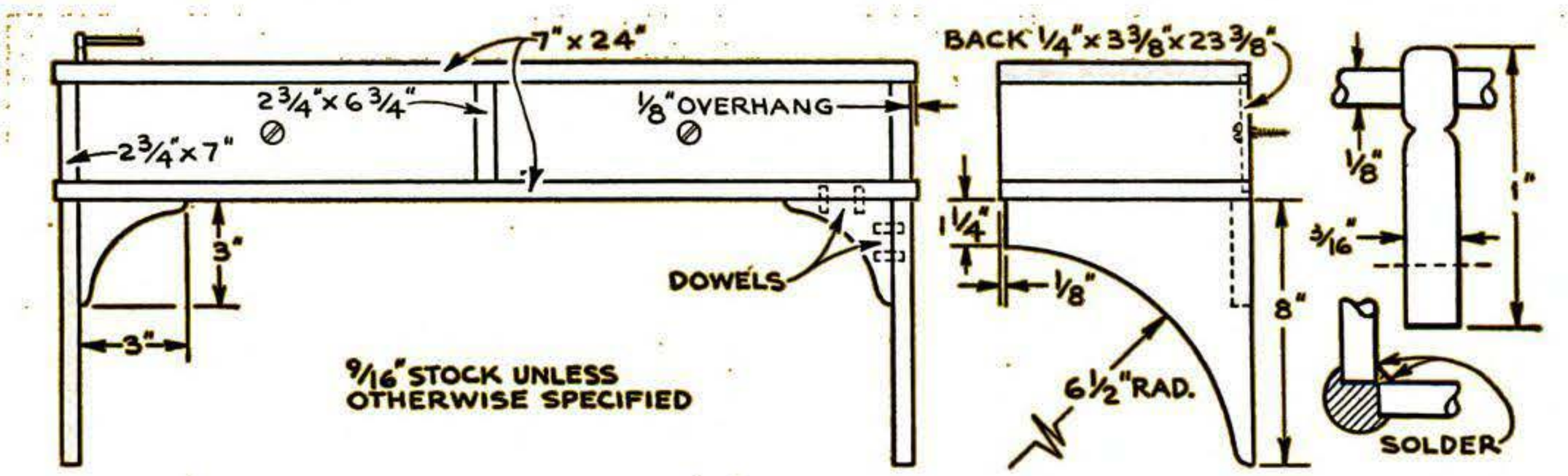
The rails are ⅛″ brass rod, posts 3/16″ brass rod. The posts can be shaped by chucking in a drill press, rounding the ends, and forming the groove with a triangular file. Two posts with right-angle holes are needed for the corners. Solder the rails to these only, or braze them for a better color match. Tap the posts into undersize holes. —*Walter E. Burton, Akron, Ohio.*



A simple jig, above left, is used to drill the cross holes in brass posts for the rail. Jig consists of two holes through scrap steel at right angles. Dowels attach brackets, right.



Drawer details are shown above. Groove front for a decorative effect and install brass knob.



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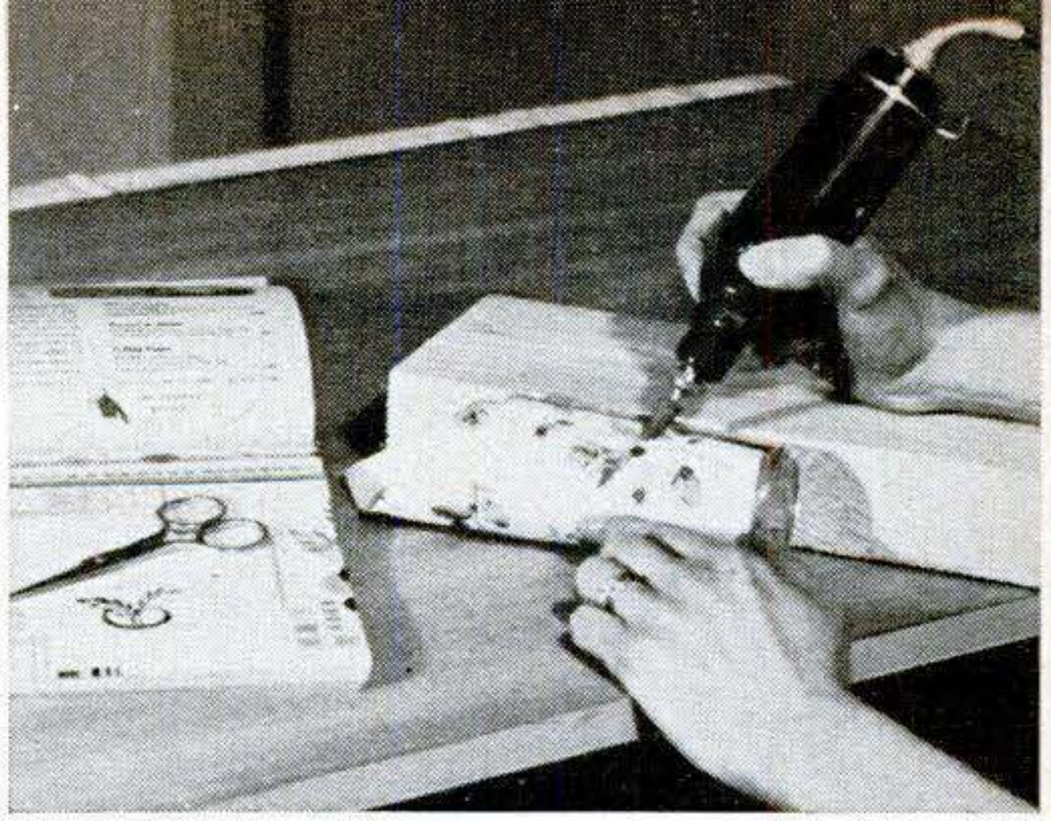
Insert Prevents Shocks

A BUTTON-SHAPED flexible insert, pressed permanently into a light socket, prevents shocks to probing fingers. The brass center ring makes contact only when a bulb is screwed in but breaks the circuit when the bulb is removed. Shock Stopper® is manufactured by Container Specialty Co., Cleveland, and is priced at three for 25 cents.

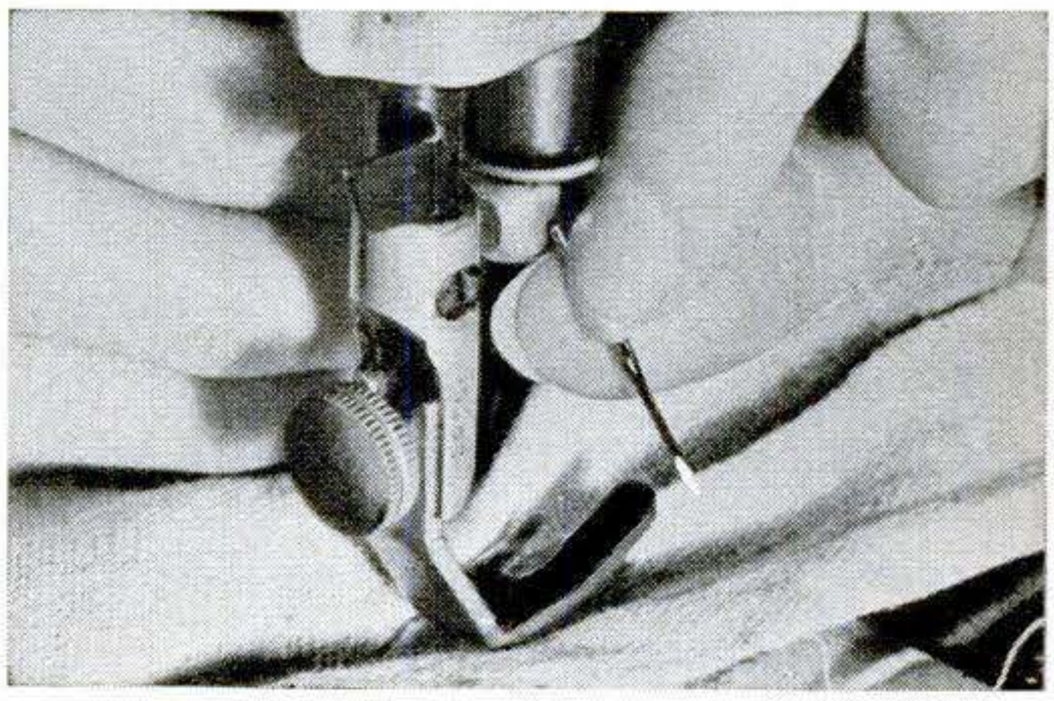


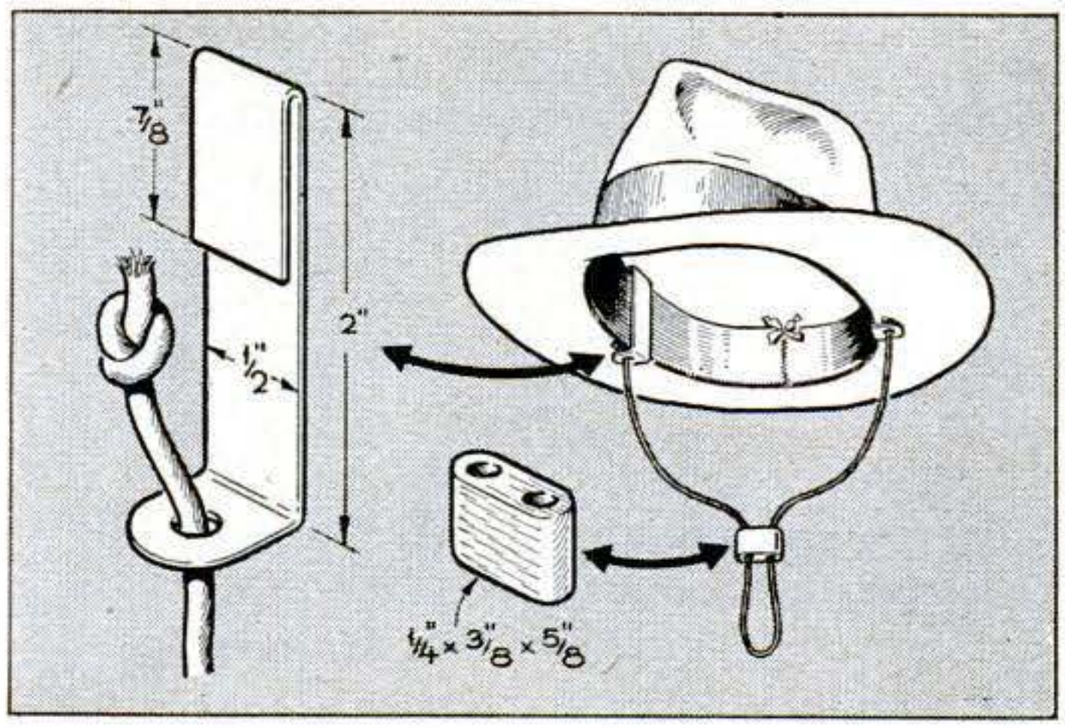
Wallpaper Provides Patterns

FOR engraving tumblers with a hand grinder, you'll find a wide variety of designs in a wallpaper sample book. Cut out the pattern, leaving enough margin to encircle the inside of the glass and to rest on the bottom. Stuff cloth inside to hold the design in place while engraving. Use a cone-shaped point.—*Ralph S. Wilkes, Keuka Park, N. Y.*

Seams Ripped on Machine

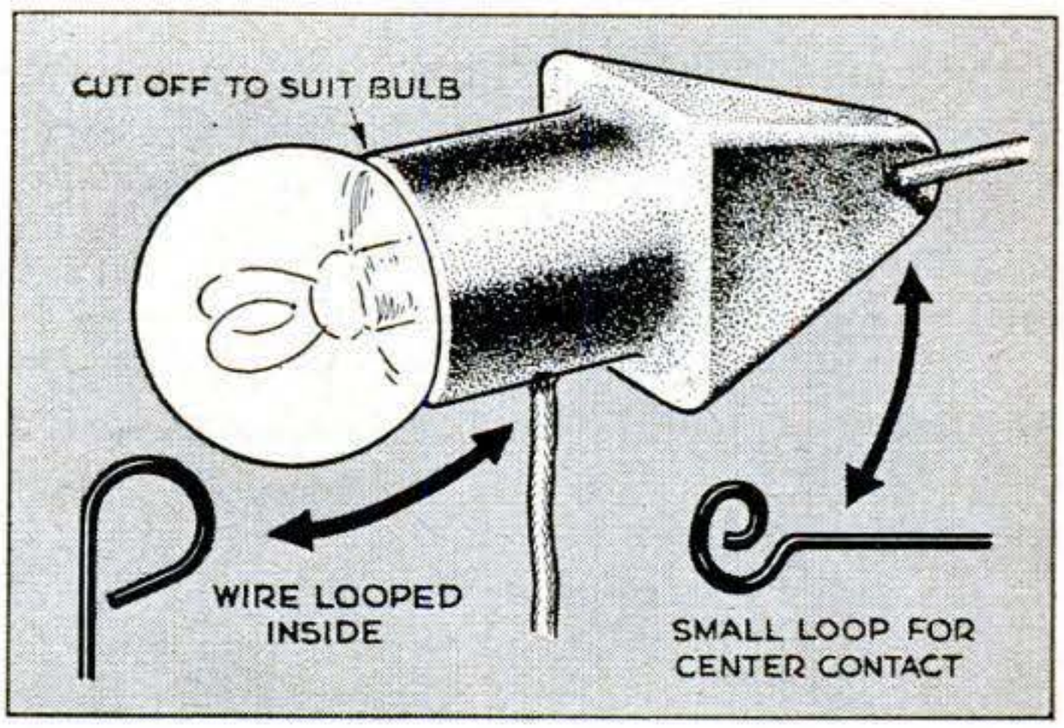
INSERTED instead of the needle, this knife-edged attachment rips seams just about as fast as they were sewn in by the machine. The ripper penetrates material by spreading the weave without cutting the cloth. Machine-sewn seams, more taut than the material, resist the ripper's pressure and are cut. Then the seam is pulled apart. The device is made by the Gilman Engineering and Manufacturing Co., Janesville, Wis.





Metal Clips Hold Hat Cord

THIS simple hat cord, secured to the sweatband by two metal clips, keeps your hat in place in wind or weather. It can be transferred from one hat to another, since the clips are slipped over the band and held by pressure when the hat is worn. Bend up the clips from tin-can stock and use plastic cord.—*N. Yonteff, Bronx, N. Y.*



Erasers Make Model Sockets

FLASHLIGHT sockets for models can be made from ordinary slip-on pencil erasers. Cut off enough of the rubber so only the metal part of the bulb is covered. Punch a hole in the side and another in the end. Push contact wires through the side and end, looping them as shown in the drawing above.—*Howard Fischer, Monaca, Penn.*

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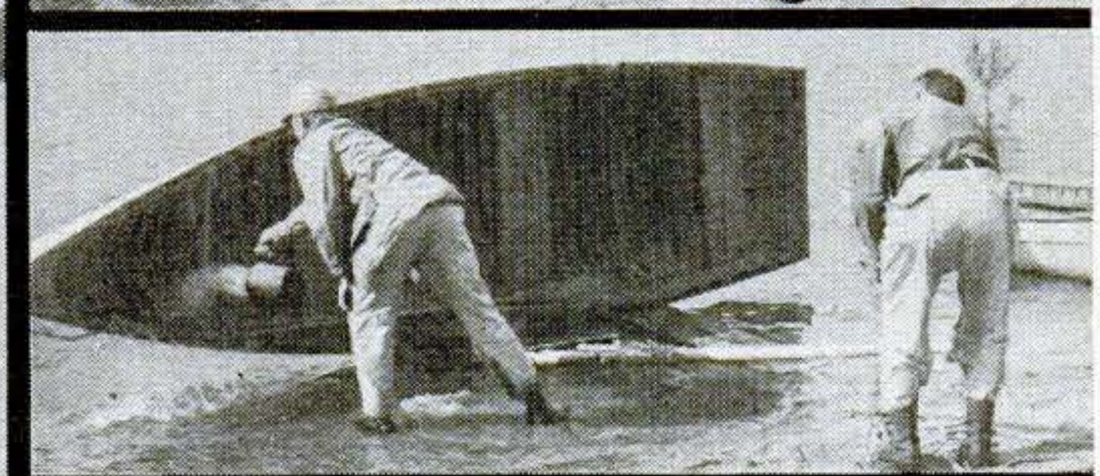
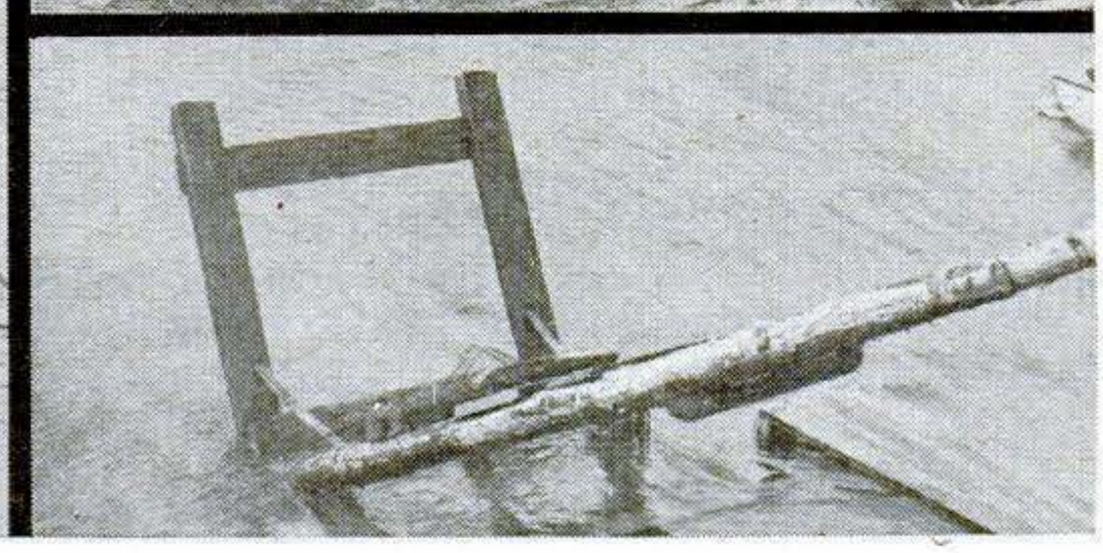




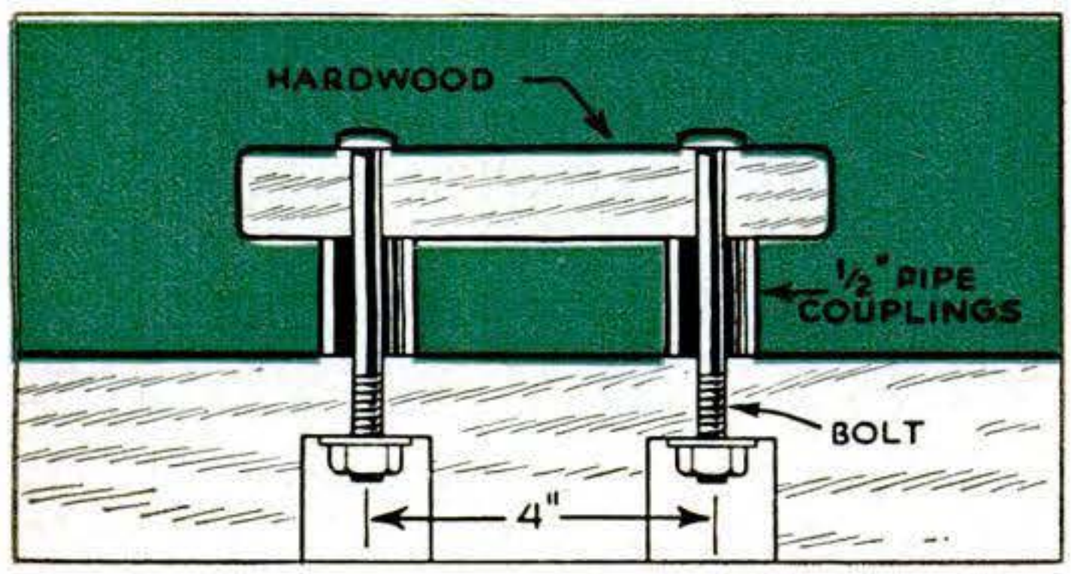
Rig Tips Boats for Cleaning

SKIDDING a rowboat ashore to tip, drain, and clean it can be quite a chore, especially if one man has to do the job. A simple rig that will do everything but clean the boat for you can be built of scrap lumber and a couple of saplings. The one pictured in use at a fishing camp near Remer, Minn., is being handled by two men. Lashing down the top of the mast when the boat is tipped would make it a one-man job. The setup can be assembled in less than an hour.

The mast is a pine sapling about 12′ long. Wired to the mast about halfway up are the ends of two 6′ saplings. The other ends of these are spread to form a triangle and the bases of all three are nailed to a two-by-four. At right angles to the triangle, two two-by-fours were nailed to the bottom board. Iron braces join these and the two shorter saplings. A few scrap boards are nailed across the triangle to brace it.

A short piece of wood is secured with a single bolt to the cross brace just above the boat's gunwale. When the rig is placed against a boat, this pivoting piece is turned parallel to the mast, clamping the gunwale to the rig.

In use, a boat is floated or skidded onto the rig and clamped. Then a rope tied to the top of the mast is pulled to tip the boat. *—Henry E. Bradshaw, Des Moines, Ia.*



Pipe Couplings Space Cleat

QUICKLY installed mooring cleats for a small dock can be made of hardwood, bolts, and brass pipe couplings. Drill the hardwood and the dock at the same time. Then you'll be sure the holes align. If the dock member is too thick for the bolts you have, counterbore from underneath as at left. *—Carl V. Hanson, Renton, Wash.*

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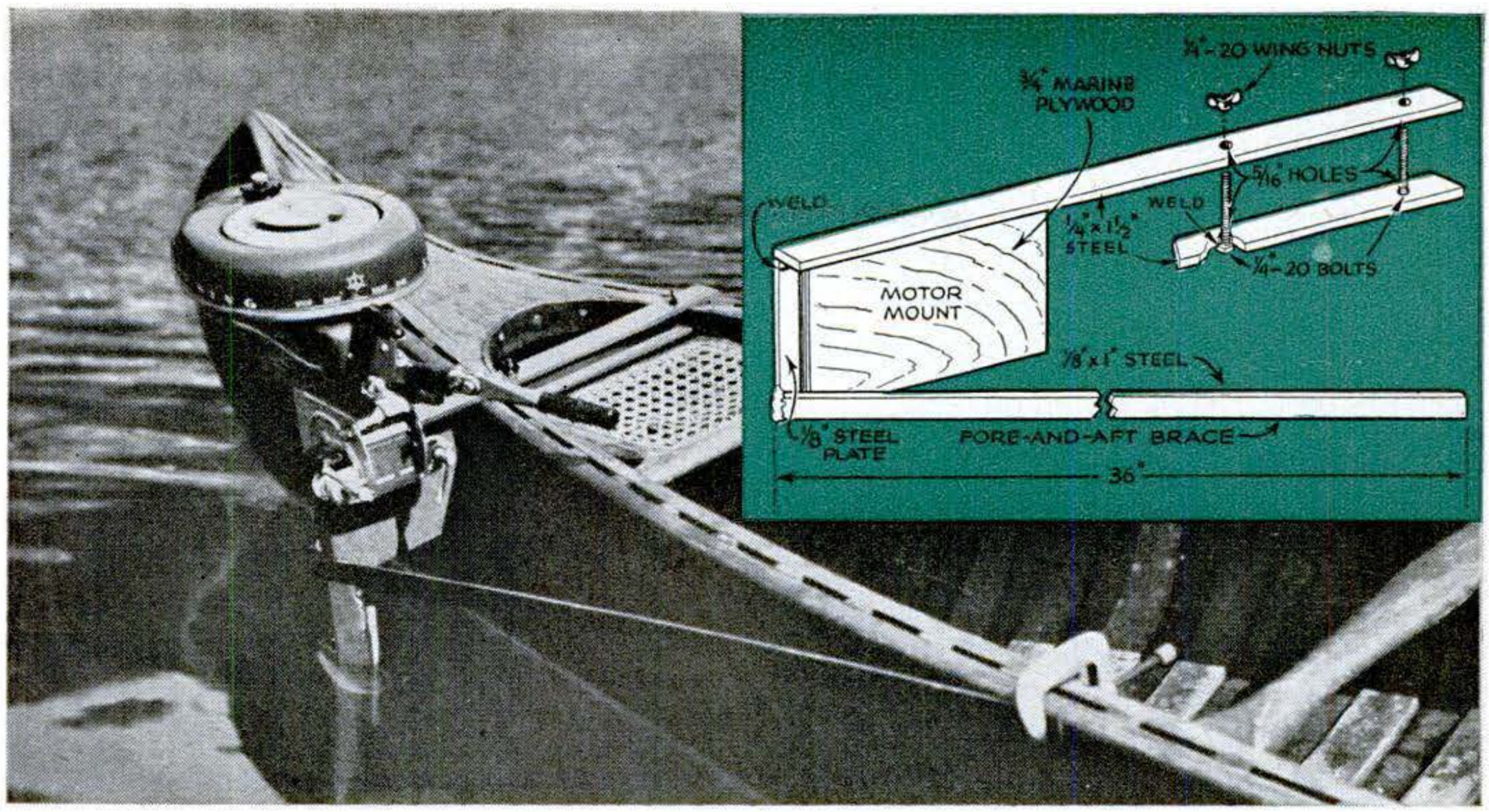


Bracket Mounts Outboard Motor to Power Canoe

No HOLES need be drilled nor any other changes made in a canoe to mount this motor bracket. It's sturdy enough to handle a 1½-hp. motor easily, and it can quickly be attached or removed without tools. Two wing nuts and a C clamp hold it securely.

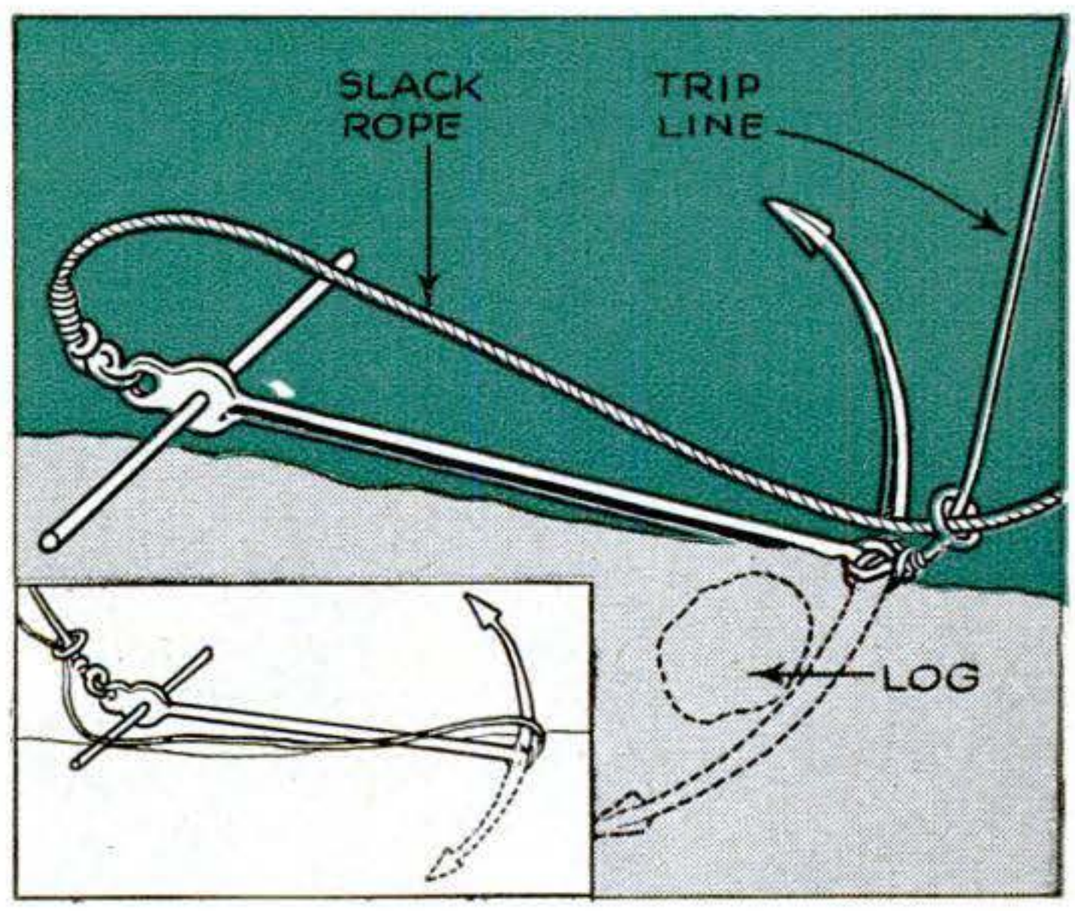
The motor mount is a ⅛" by 5½" by 7" piece of steel that's welded to the main support. As padding between the steel plate and the motor clamps, I used ¾" plywood the same size as the plate. Four ¾" flathead wood screws, countersunk, hold the plywood and steel together. You'll have to chamfer the top inside edge of the plywood to clear the weld bead.

One end of the 36" fore-and-aft brace is welded to the lower outside corner of the motor mount at such an angle that it meets the outside of the canoe gunwale. This angle will vary with different canoes. The brace serves two purposes: to absorb some of the forward thrust and upward twist exerted on the mount by the motor, and to protect the protruding motor from hooking on a dock or piling. The forward end of the brace is held to the gunwale by a C clamp.

The lengths of the main support and the shorter one that fits beneath the inwales will depend on your canoe. Two wing nuts pull the shorter support up under the inwales. The heads of the two ¼"-20 brass bolts are brazed to the underside of the smaller support. Red-lead the bracket and then paint it to match the canoe. In laying out the bracket, take care that the motor is out far enough to clear the side of the canoe through the full steering range.—*William A. Poellmitz, Schenectady, N. Y.*

Line Clears Fouled Anchor

When the anchor of a small craft is caught under a rock or log, you usually can pull it free if you've rigged it in this way. Where the shank of the anchor meets the arms, make fast a 3/16" line that's the same length as the anchor line. Slip the free ends of both through a 2" ring. Slack off on the smaller line when at anchor. The ring will rest at the anchor's stock. Pulling on the small line will ordinarily free the fluke. If the anchor is badly fouled, run the boat straight ahead, keeping the smaller line taut until the anchor is clear. Then haul in both lines.—*N. C. Darling, Danbury, Conn.*



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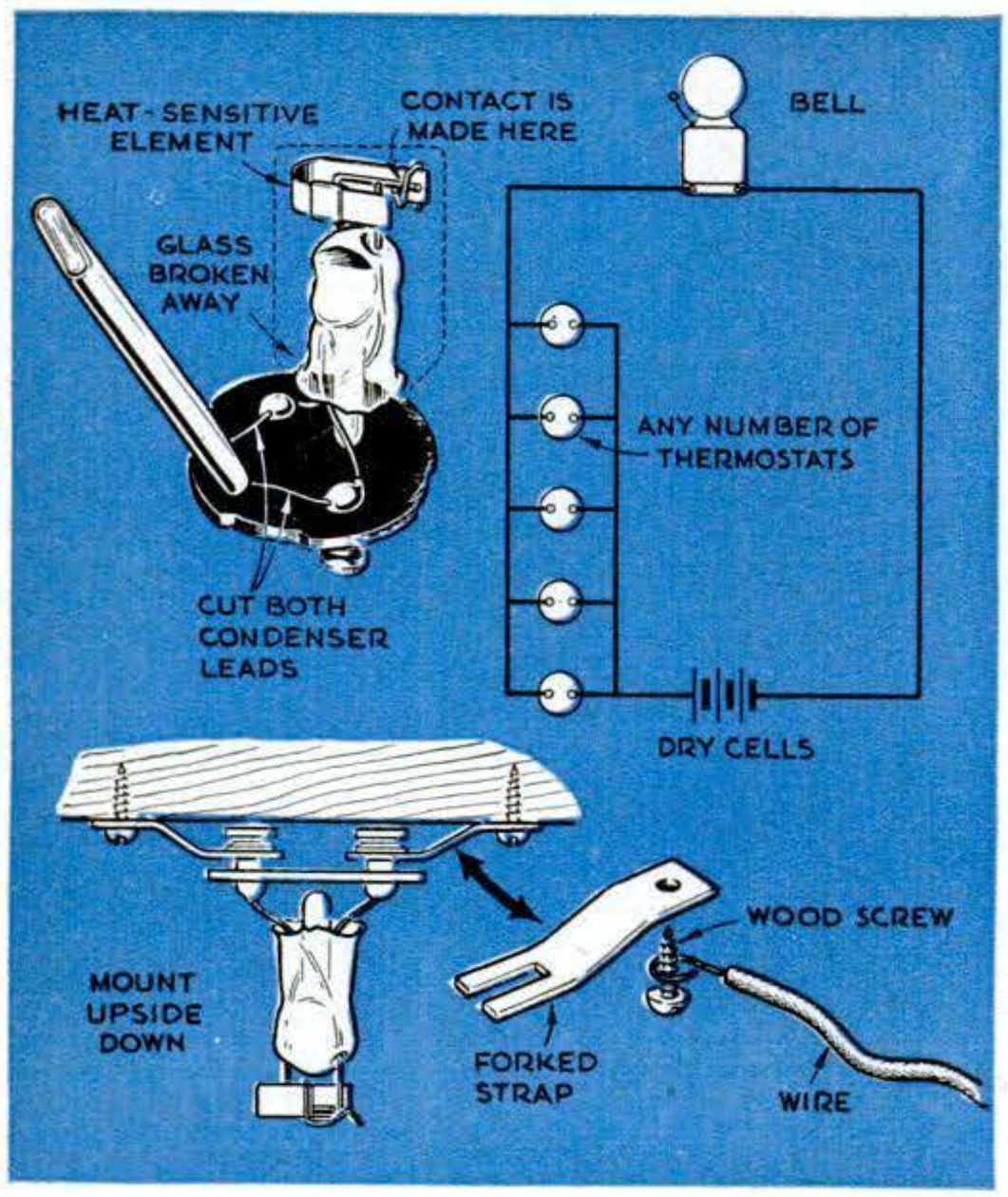
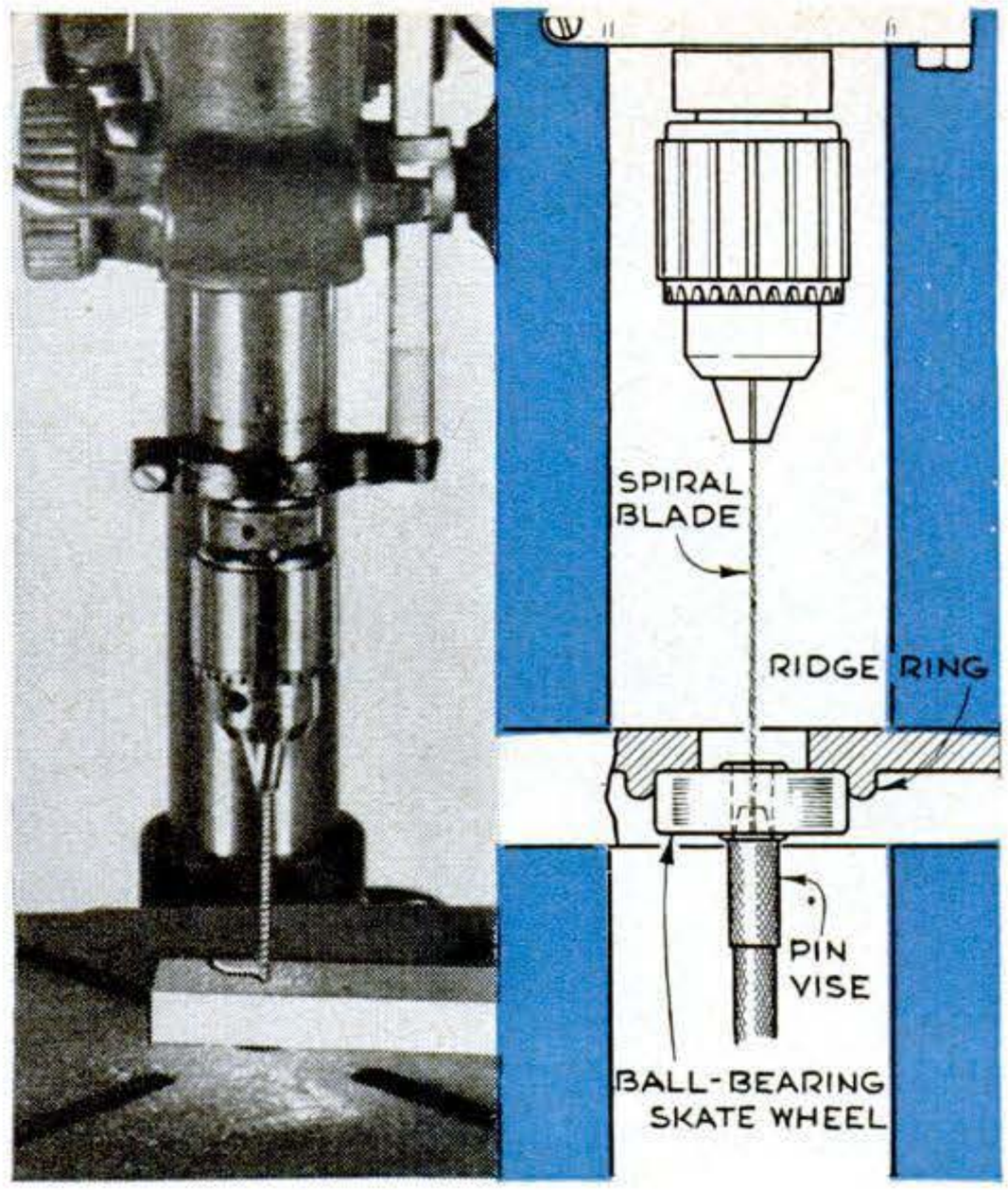


Tube Starter Is Fire Alarm

FLUORESCENT-TUBE starters that have glass-enclosed heat-sensitive switches may be converted to small but reliable thermostats. One excellent application for them is in a homemade fire-alarm system that will protect your home, shop, or garage.

Pry back the tabs that hold the aluminum cover on the starter and remove it. Taking care not to damage the bimetallic element inside, break away the glass envelope to expose the U-shaped strip and contact wires. Cut off and discard the condenser.

If you wish to make a fire-alarm system, mount the thermostats inverted, holding them with two forked, screw-held metal strips. Stairways, corridors, and the vicinity of stoves and heaters are likely locations. Wire them in parallel with each other and in series with dry cells and a loud bell. Test regularly by holding a match 1″ underneath. —*Harold Kruer, Covington, Ky.*



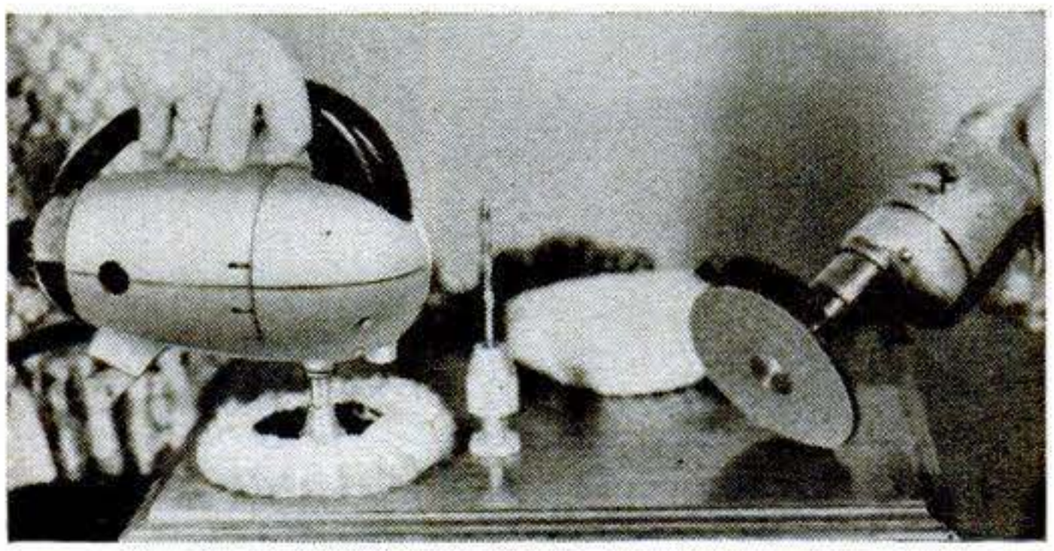
Drill Press Used as a Jigsaw

IN A pinch you can rig up your drill press to handle small jigsawing jobs. The stunt is made possible with a coarse spiral blade held tight as it spins.

Though designed for reciprocating motion, these blades will actually spin through wood as thick as ⅞″. The dodge is chiefly useful, however, for occasional jobs on thin stock. The blade naturally wears only at the working area; when it breaks, just lower the chuck and remount it.

Clip the ends of the blade straight, chuck one end securely, and lower the blade through the center hole of the table. Lead the blade through the axle hole of a ball-bearing skate wheel that fits the cast ring usually found under the center hole of the table. Clamp the lower end of the blade tightly in a small, conical-nose pin vise. Lift the drill chuck until the blade is very taut and lock it.—*S. S. Palestrant, Bronx, N. Y.*

Mixer Motor Gets New Jobs



YOU can convert your kitchen mixer to a wider range of jobs around the house with the Toolzon®, a simple adapter that fits most mixers. Attachments include a drill chuck, buffer, and a flexible-backed sanding disk coated with aluminum oxide. The bonnet of the buffer is ¾″ wool pile. Made by the Towle Manufacturing Company, of Walnut Creek, Calif., the attachments are priced at about $3.25 each. The attachments also can be fitted into the chuck of electric hand drills.

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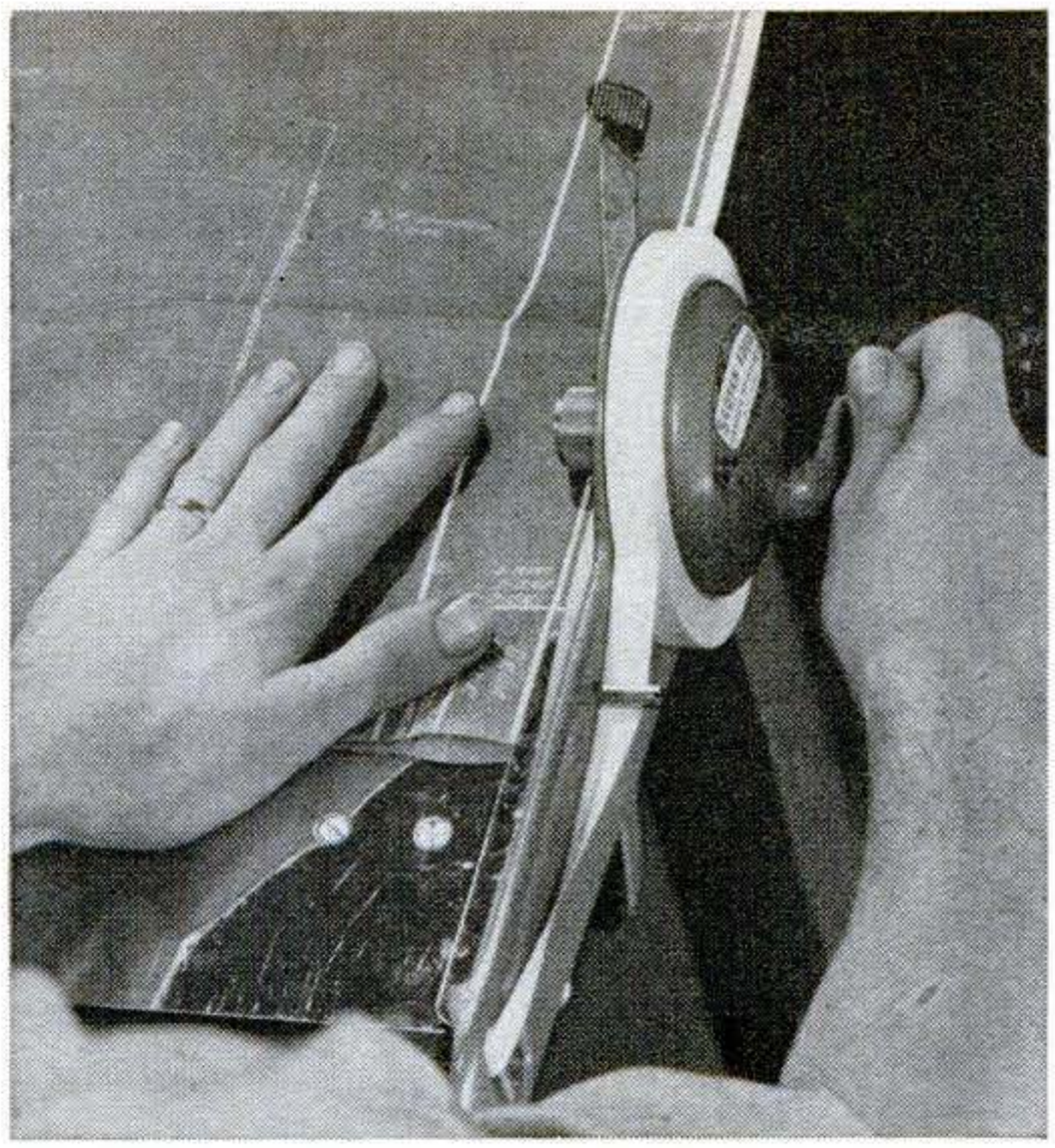
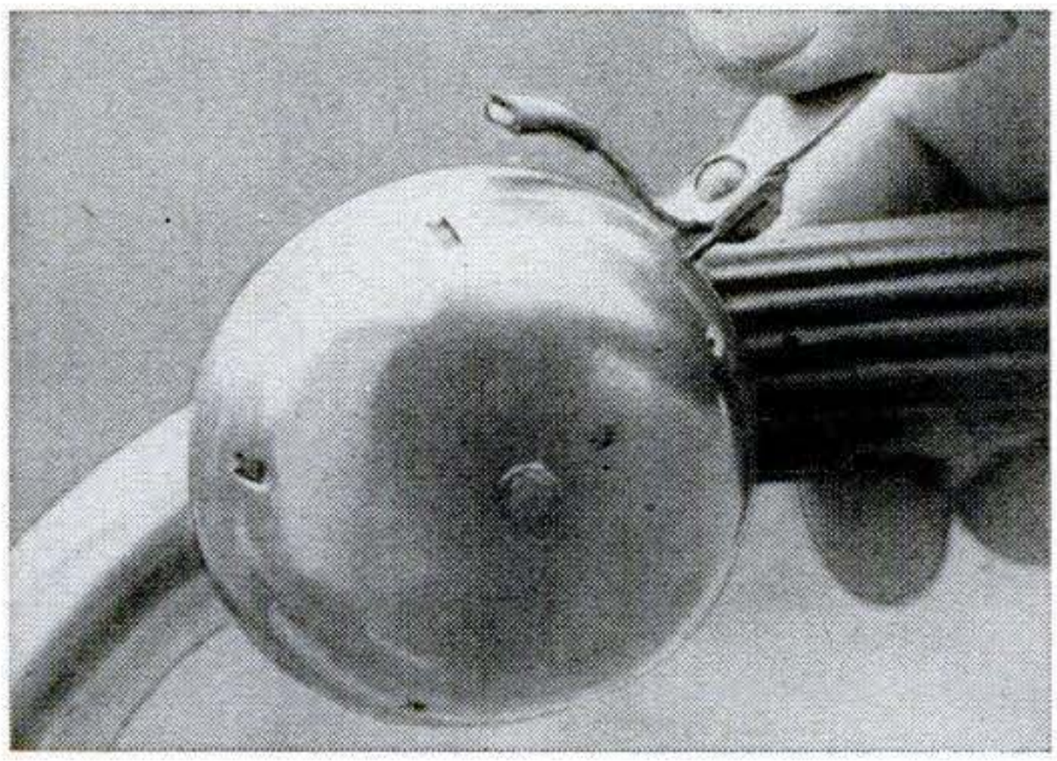


Tape Binds Edges of Papers

EDGES of blueprints, maps, sheet music, and other frequently handled papers can be kept from fraying by binding with tape. A tape dispenser produced by Minnesota Mining & Mfg. Co., St. Paul, Minn., is designed especially for this job. It can also be used to reinforce the fold in sheet music and other papers. An automatic adjustment accepts thicknesses of paper up to 1/16". The edger takes either ½" or ⅜" tape.



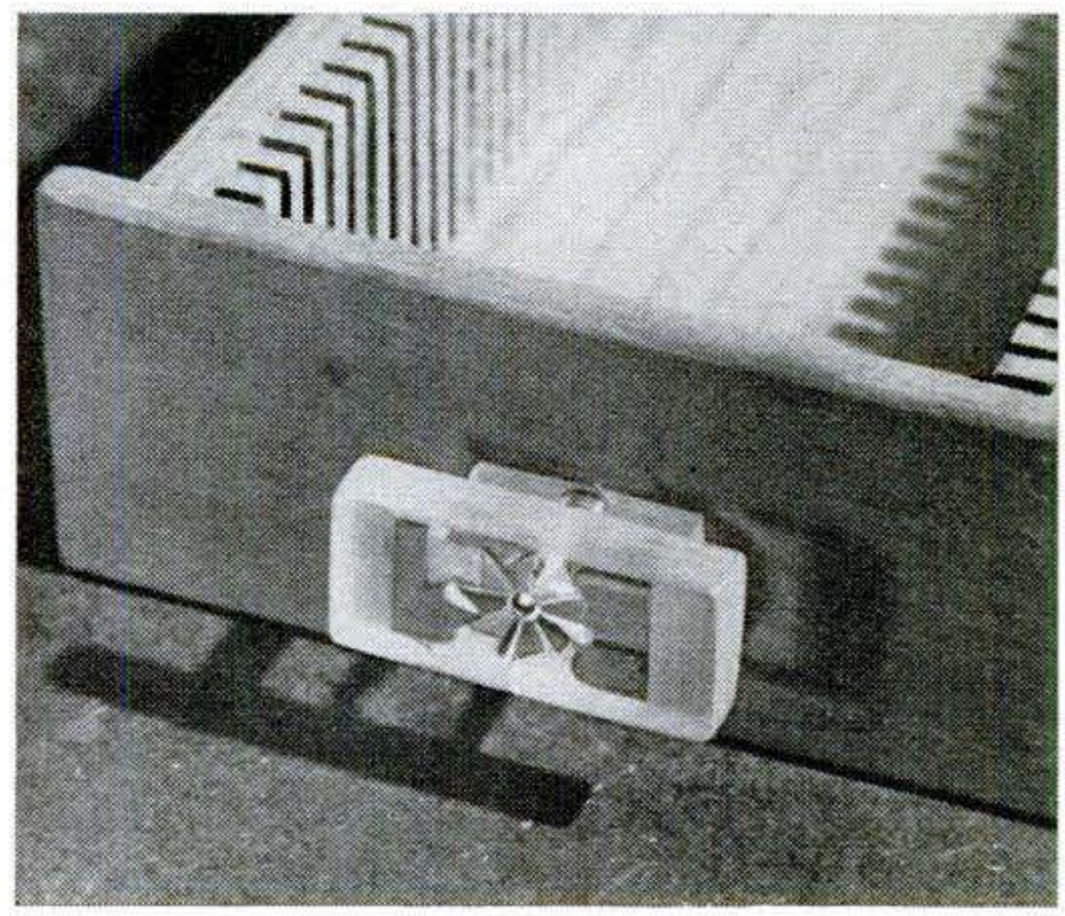
Muffler Quiets Bicycle Bell

ROUGH paving often causes a bicycle bell to jingle. Here's a muffler that will stop this. It consists of rubber tubing fitted on an aluminum extension bolted to the regular operating lever. The extension is shaped so the rubber rests against the bell while the latter is not in use. If the clapper bounces, the rubber muffles the sound. The extension doesn't hinder normal operation of the bell.—*John M. Avery, Dexter, N. Y.*

Shop Tools Emboss Plastic

ANY plastic that softens when heated can be decorated by embossing with countersinks, end mills, and other common workshop tools. Above, a ½" end mill is being used to emboss a piece of ¼" Plexiglas®. This became the drawer pull shown below.

For such work, chuck the tool in a drill press, heat the plastic until soft, rest it on a piece of glass or polished metal on the drill press table, and bring the tool down against the plastic by operating the spindle feed. Unusual designs can be made by pressing knurled surfaces, fancy metal buttons, printer's ornaments or type, and other objects down against the softened plastic.



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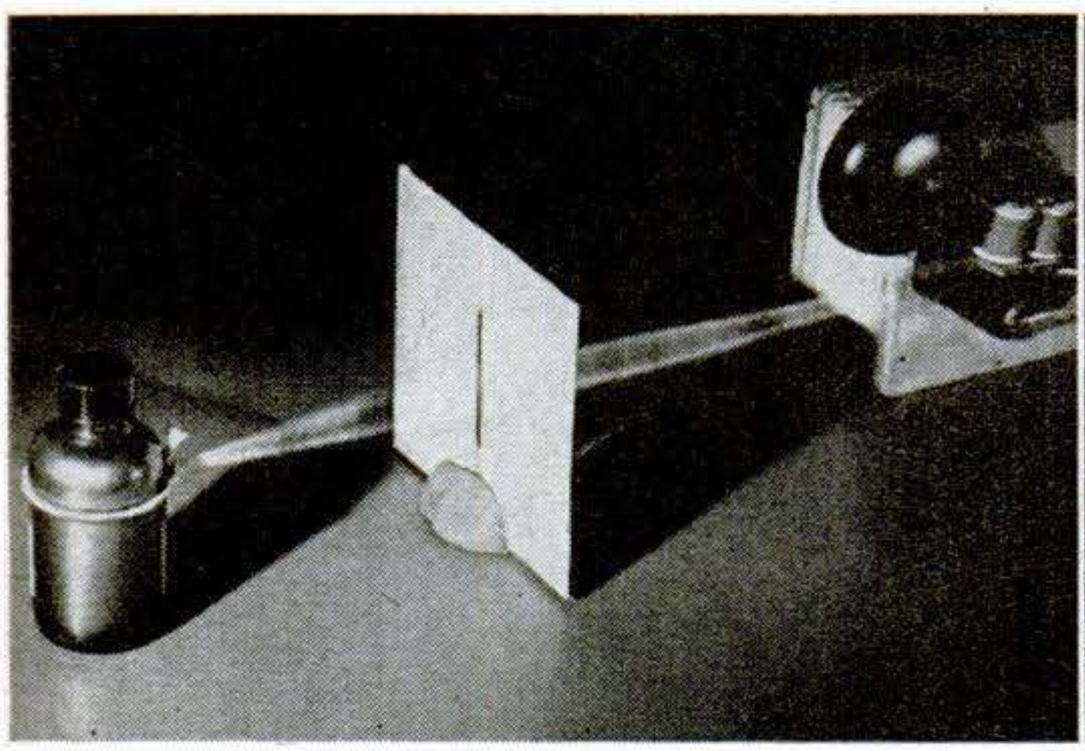
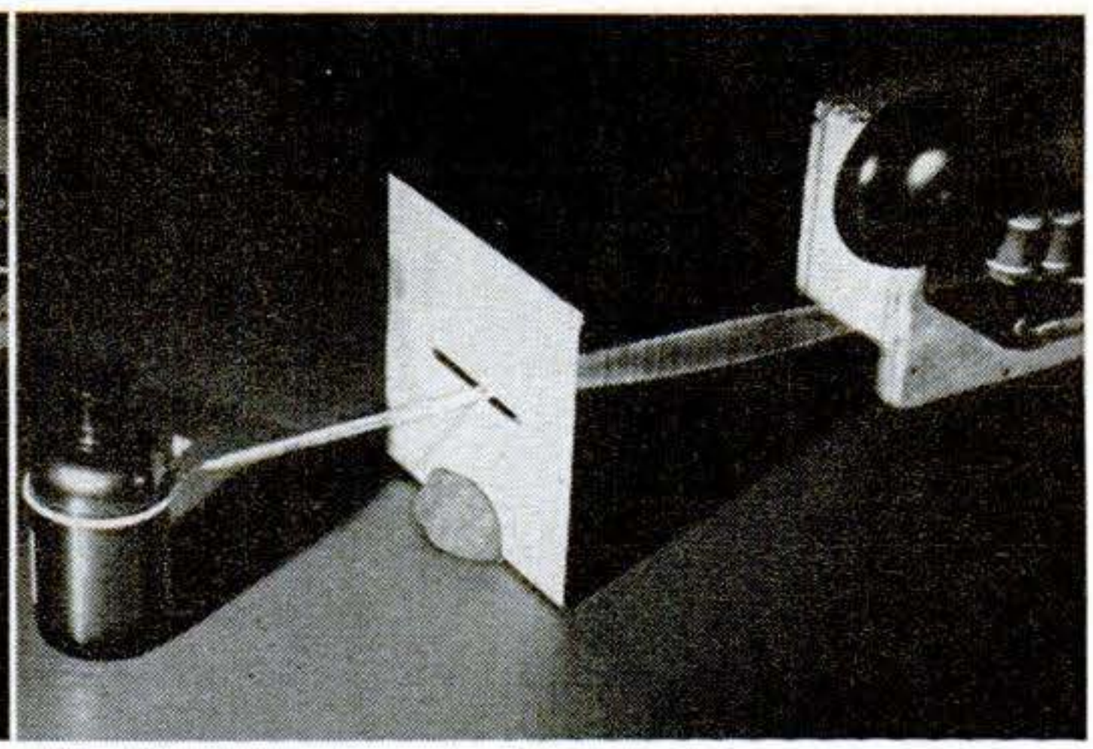




Vibrating string shows principle of polarized light. If slot in cardboard above is parallel to direction of vibration, string vibrates freely. But turn the cardboard 90° as at right, and string vibrates only as far as the slot. A polarizing filter stops random light in same manner.

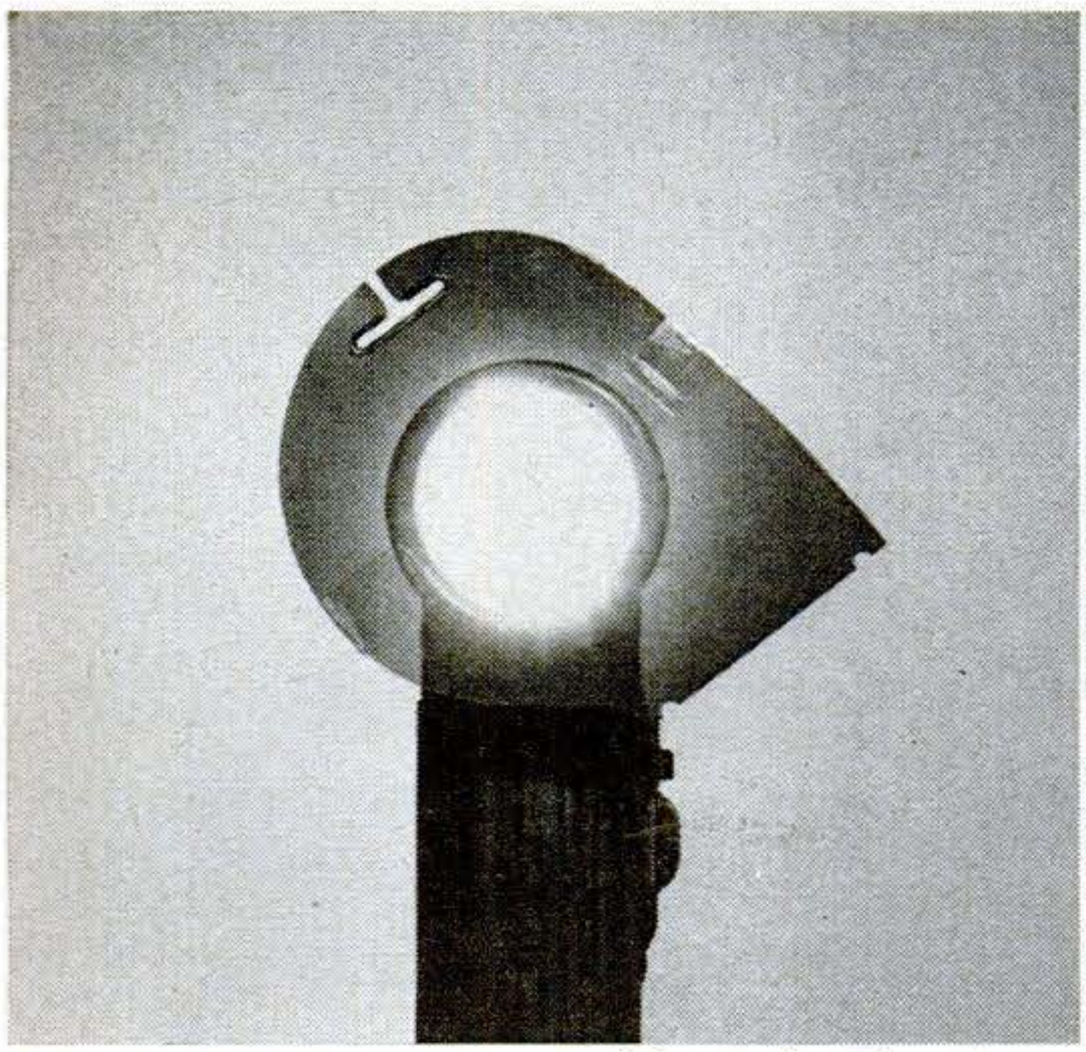
Experimenting with Polarized Light

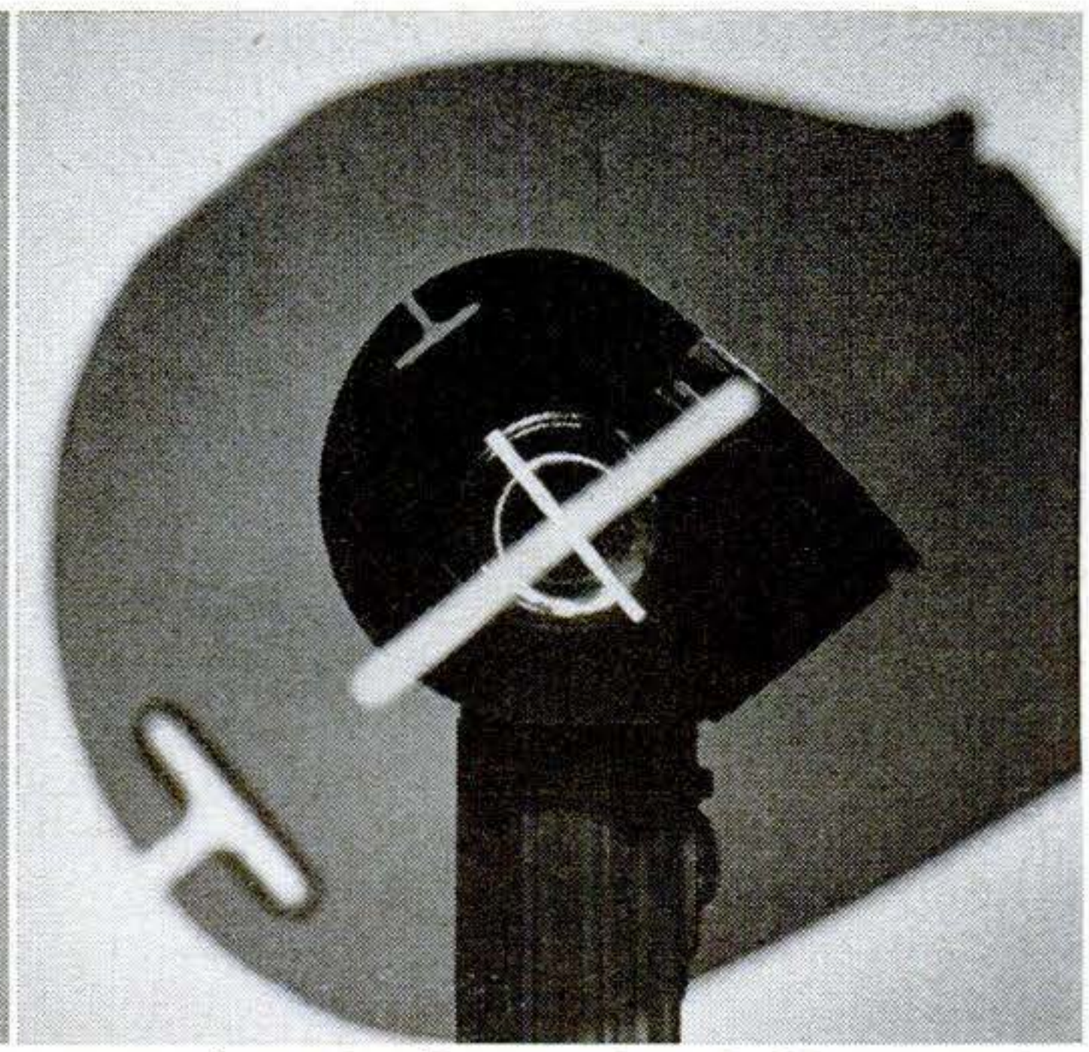
WHY will a pair of polarized sunglasses protect your eyes from glare at the beach? What happens when you use a polarizing filter on a camera? How does a polarized visor improve your driving vision?

All these useful devices rely on polarized light. Here are some experiments designed to show the characteristics of such light. The necessary equipment is simple—just two pairs of polarized sunglasses. Or you may prefer to do what I did—cut in half a pair of inexpensive army goggles. See the headlamp experiment below.

To understand polarized light, you must remember that light vibrates in all possible directions in the plane perpendicular to the line in which the light is travelling. But suppose some of these vibrations are cut off, leaving light that vibrates in only one direction? You have polarized light.

Light can be polarized in several ways. One is by means of a polarizing screen or





Polarized headlights would work like this. Put your screen over a flashlight as at left with its crystals arranged diagonally, to represent an approaching headlamp. Then hold up another screen at the opposing angle. This, like a polarized windshield on a second car, cuts glare.

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filter. This is a grille consisting of myriads of microscopic crystals, aligned in a single direction in transparent plastic.

When ordinary light strikes such a screen, only that part vibrating in a line parallel to the aligned crystals passes through. The rest is stopped. On the other side, the polarized light will also be stopped if it strikes a second screen turned with its crystals at right angles to those in the first.

A simple mechanical analogy at the top of the facing page shows why. Here one end of the string is tied to the clapper of an electric bell, the other to a fixed support.

Vibrated up and down by the bell clapper, the string can be likened to light that has been polarized by passing through a single filter. If another filter, in this case the slot in the cardboard, is arranged in the direction of the vibration, the wave goes through. But turn the screen at right angles and the vibration is stopped.

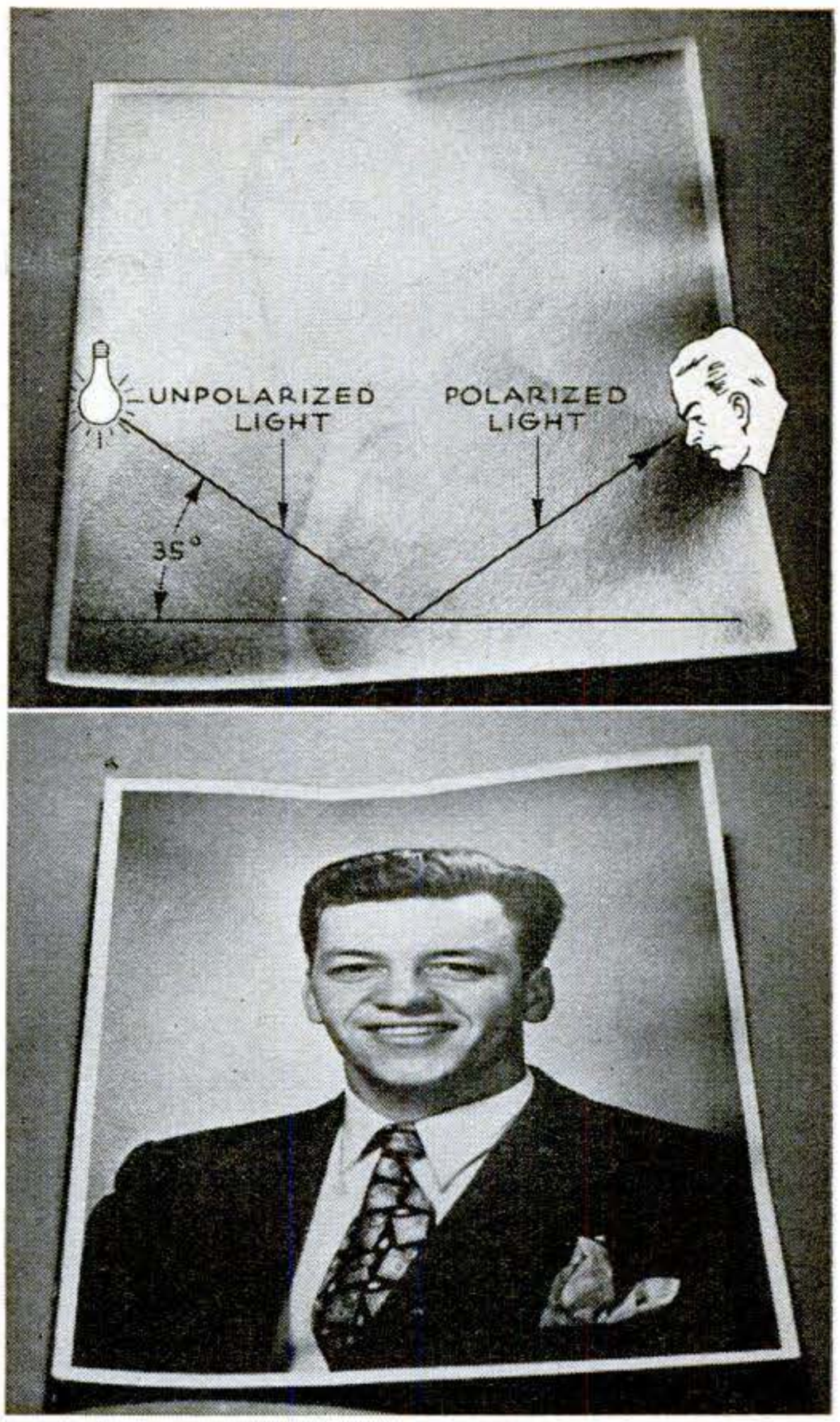
It has been proposed that automobile headlights make use of this principle to control glare. Polarizing screens would be placed over the lamps with their crystals aligned diagonally. Another screen would go on the windshield with its crystals aligned in the same direction.

When two cars so equipped face each other on the highway, the polarizing screens —the one on your windshield and those on the lamps of the other car—would cross at right angles. The other man's headlights wouldn't bother you, although you could still see the highway perfectly well.

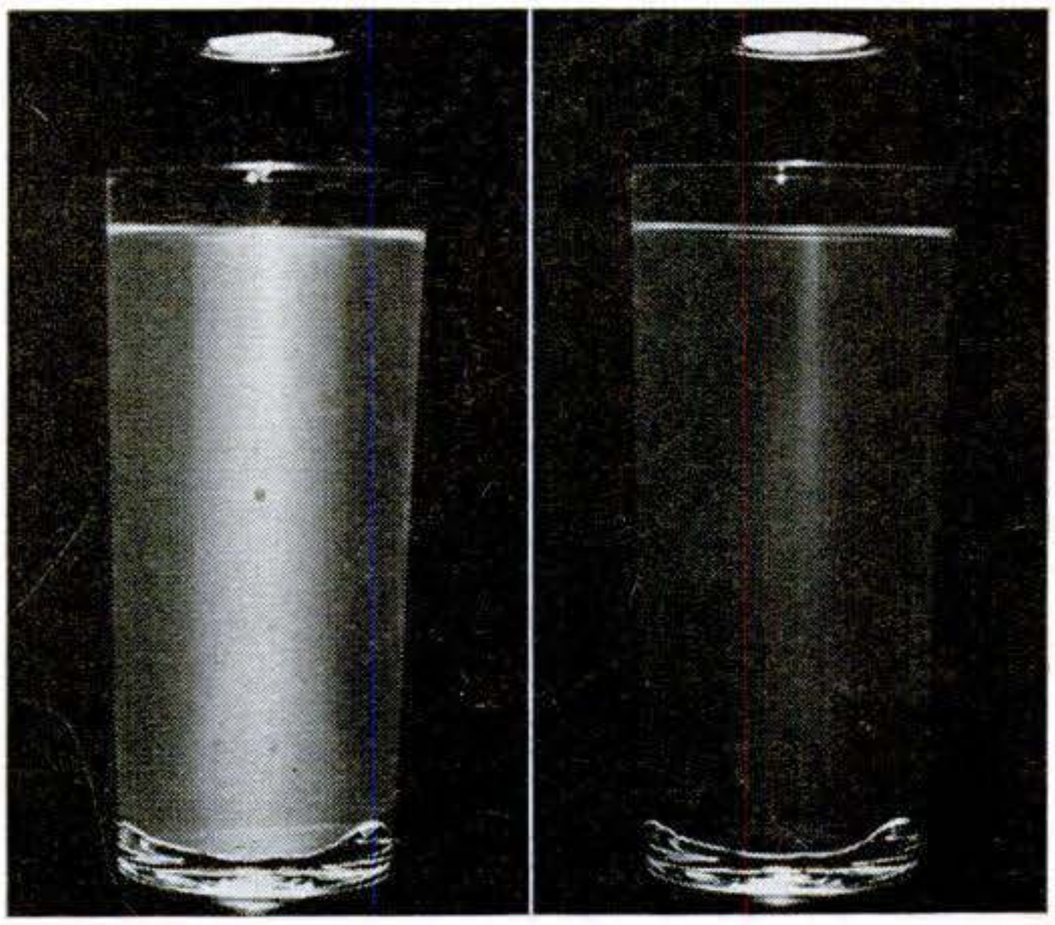
A flashlight and two polarizing screens will enable you to demonstrate this. In the photos on the facing page, a piece of tape was stuck across the face of each screen to show the direction of the crystals.

Nature sometimes takes a hand and polarizes light through simple reflection, as seen in the adjoining column. Beach sand, glass, paper, wood, and highways may cause such polarization. This underlies the usefulness of polarizing sunglasses and car visors.

Polarization also occurs if a light beam is scattered by smoke, dust, and the like. You can show this by filling a glass with water and adding a little milk. In a dark room, shine a flashlight down through the glass. Viewed at right angles, the beam is visible. Actually some light has been polarized at right angles to the beam. You can prove this by putting on a pair of polarized glasses. The beam of light almost disappears.—*Kenneth M. Swezey, Brooklyn, N. Y.*



Light reflected from nonmetallic surfaces is often polarized. This occurs to the greatest extent if the light hits and rebounds at about 35°. View a smooth-surfaced (not glossy) photo from this angle and you'll get a lot of glare, as in the top photo. But put on your polarizing sunglasses and take a look from the same angle. You'll then see the photo clearly.



Flashlight beam shining through water colored with milk is partly polarized in a direction at right angles to the beam (left). Don your glasses and beam almost disappears (right).

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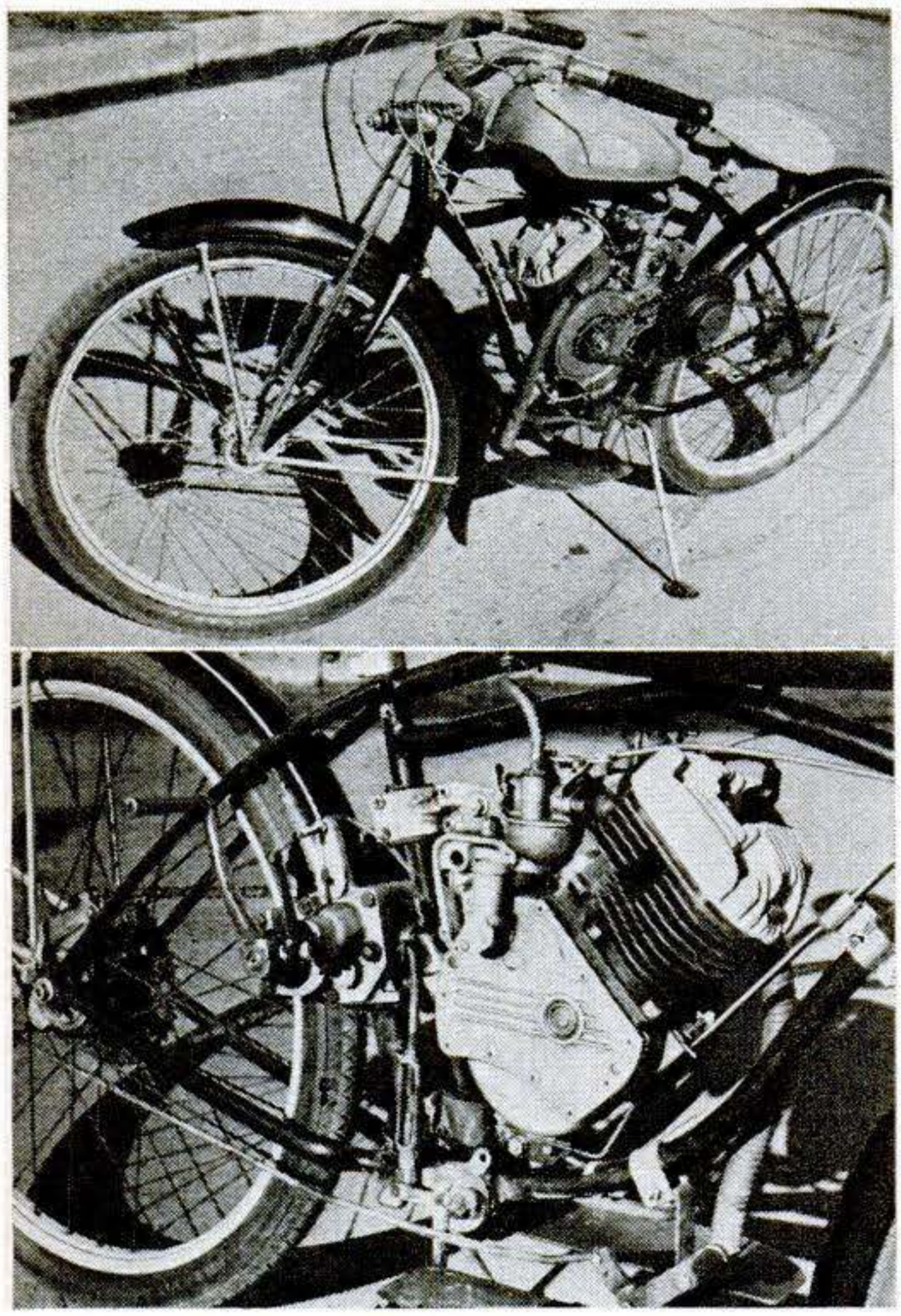
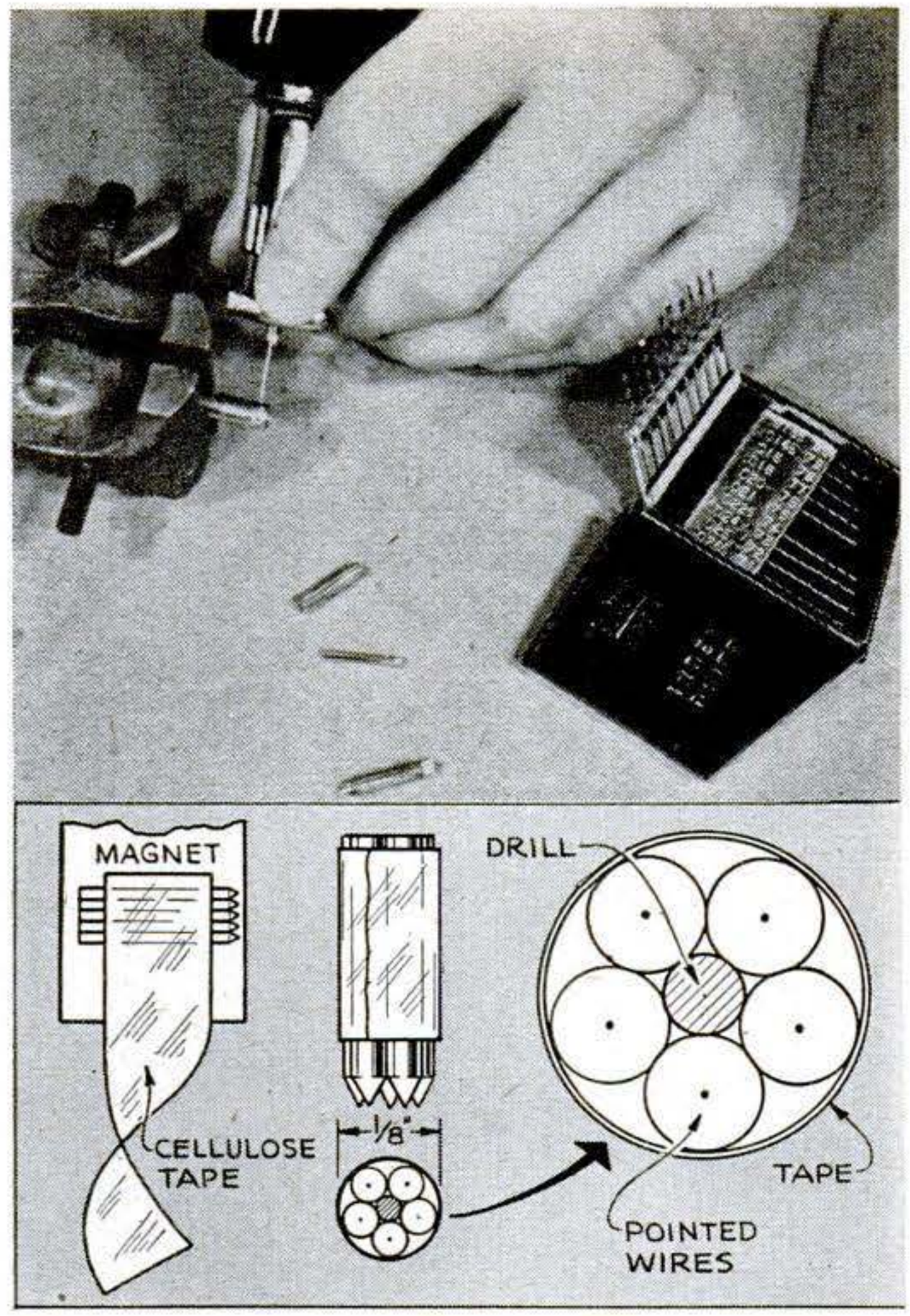


Motorbike Has Two Speeds

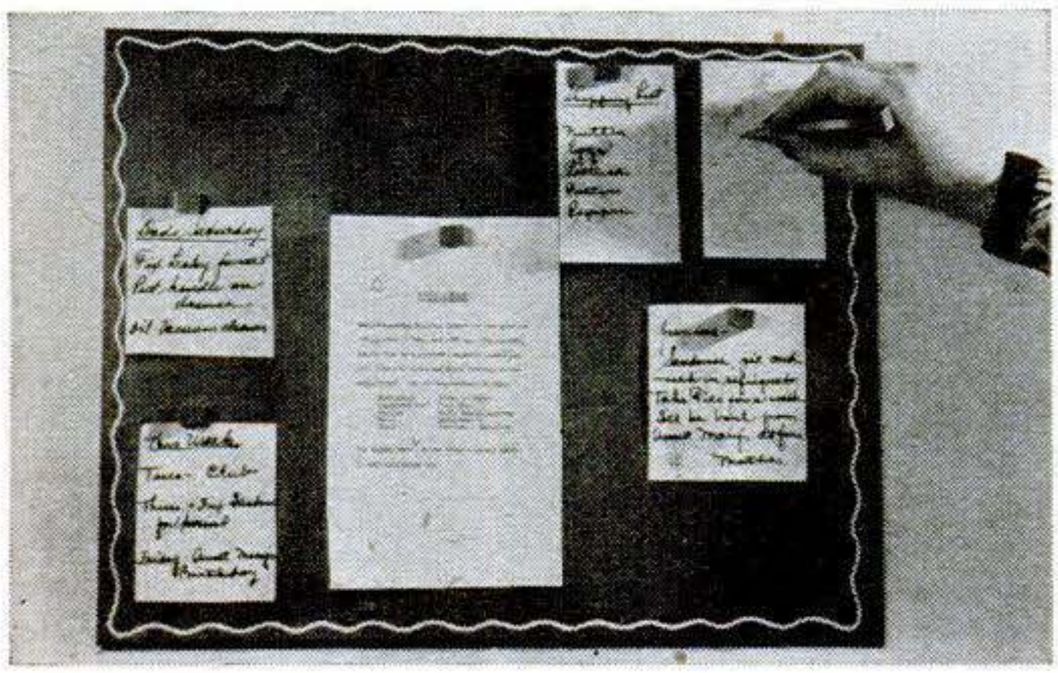
ADDING a two-speed model of the British-made Albion transmission to a standard Whizzer bike motor increased the top speed and added power on the getaway, according to Bob Pfetzing, of Moline, Ill., who built the hybrid machine. Clutch and throttle controls are hand operated, as on a standard Whizzer. Gears are shifted by foot. The pedal is just above the left footrest.

Pfetzing installed the transmission, which is fitted with a dry-disk clutch, directly behind the engine. Crankshaft and transmission are connected by a chain. Another chain drive runs from the transmission to a sprocket on the axle of the bike's rear wheel. —*Tom Griberg, Moline, Ill.*



Wire Collets Hold Tiny Drills

SMALL collets that'll equip a hand grinder to hold drills from Nos. 60 to 80 may be made from paper clips and cellulose tape. From small clips, cut ¾" lengths. Point the ends on a grinding wheel to deburr them. Lay the pointed wires on a magnet, as shown in the sketch, and press a strip of tape over them. Pull them off the magnet with the tape and bend the tape around them to form the collet. Insert a No. 60 drill in the collet and wrap enough turns of tape around the collet to make it fit snugly in the ⅛" collet of the hand grinder. Five-wire, four-wire, and three-wire collets will hold drills up to No. 80. The three-wire collet may be soldered instead.—*Don Pittwood, Moscow, Id.*



Magnets Hold Memos

THIS 14" by 18" magnetic bulletin board for the home comes with six small magnets that anchor memos and shopping lists to the board. A magnetic pencil holder also is included. Magnetic Merchandising, Inc., New York City, prices the board at about $2. Slots in the top corners of the board's back cover let you hang it on small screws driven into a wall. The board is available in three colors: red, yellow, and blue.

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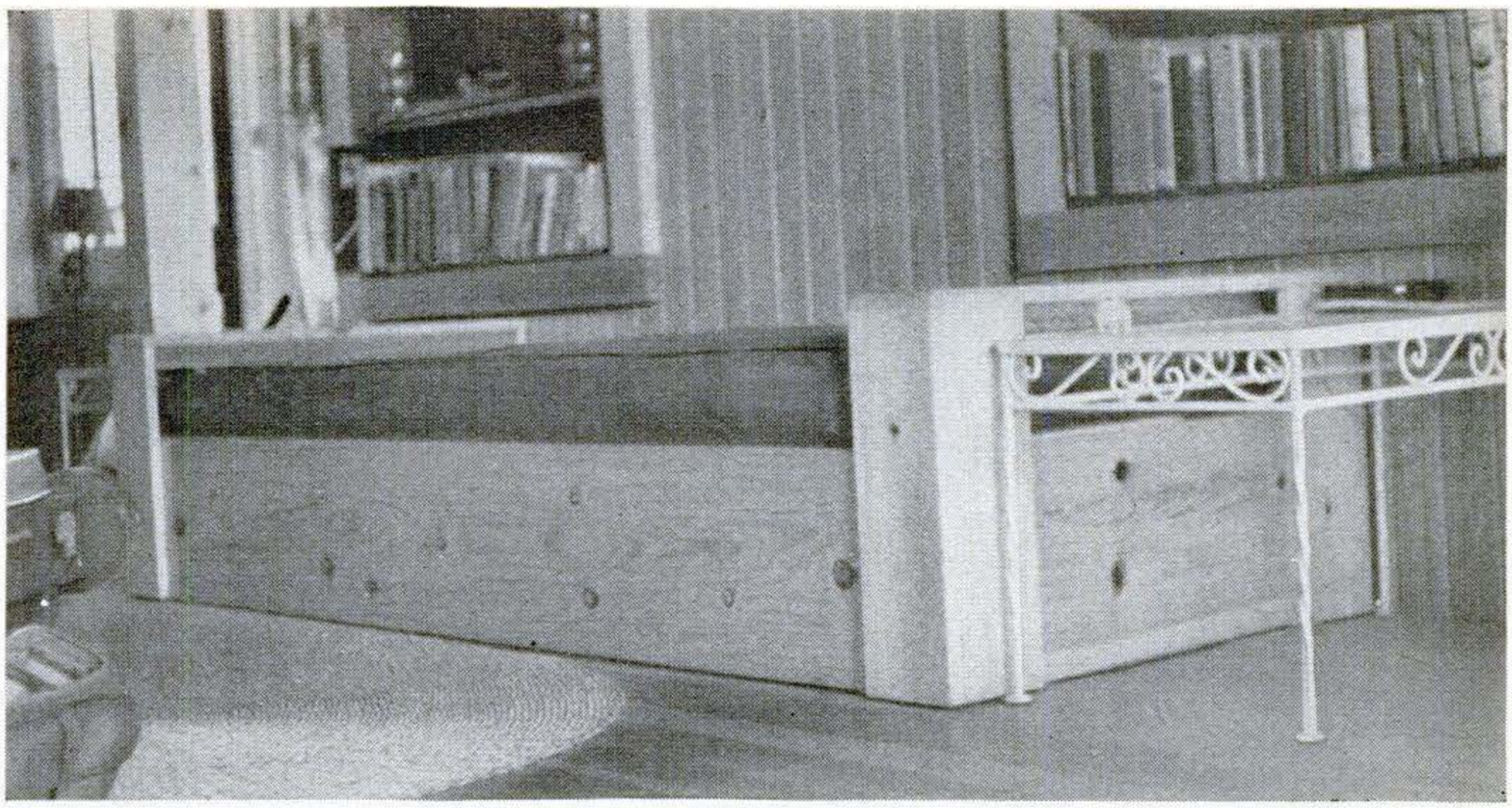
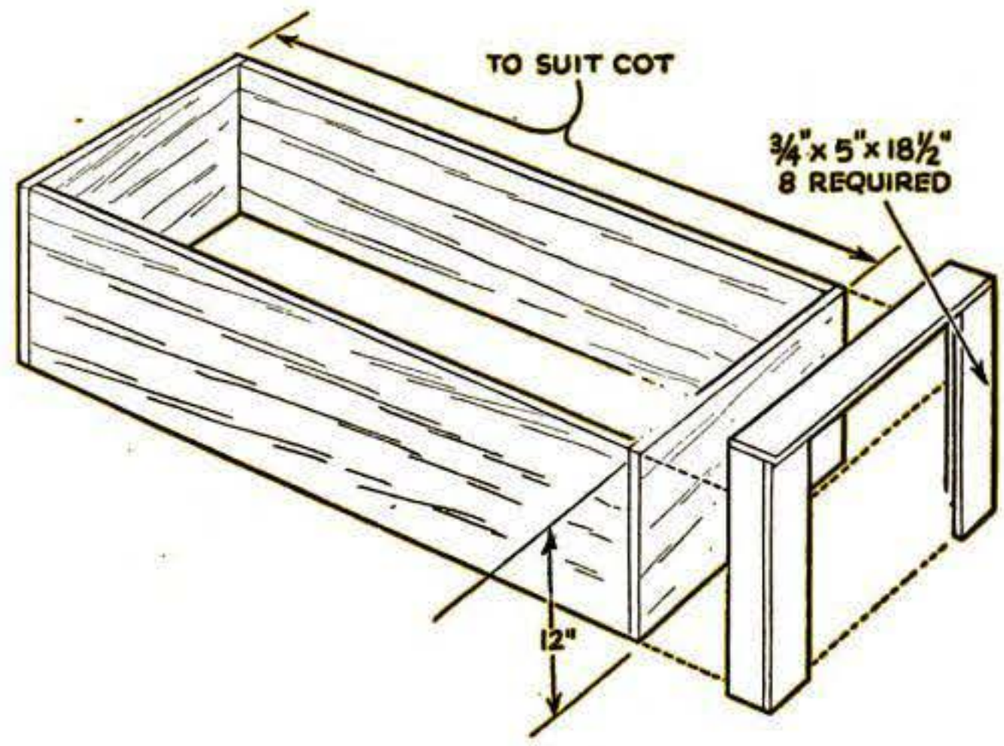


Cot Boxed In to Make Day Bed

A FEW pine boards and hand tools transformed an inexpensive iron cot into the day bed pictured above—a welcome addition to a playroom, porch, or summer cottage. The boards make a framework that fits over and conceals the cot.

The first step is to cut down the cot, if it needs it. I hacksawed the legs of mine so that the height from the top of the springs to the floor measures 11½″. Saw the 1″ by 12″ sideboards to suit the length of the cot. When laying out the 1″ by 12″ endpieces, add twice the stock thickness to their length. This addition lets the endpieces lap the sides. Nail or screw the sides and ends together.

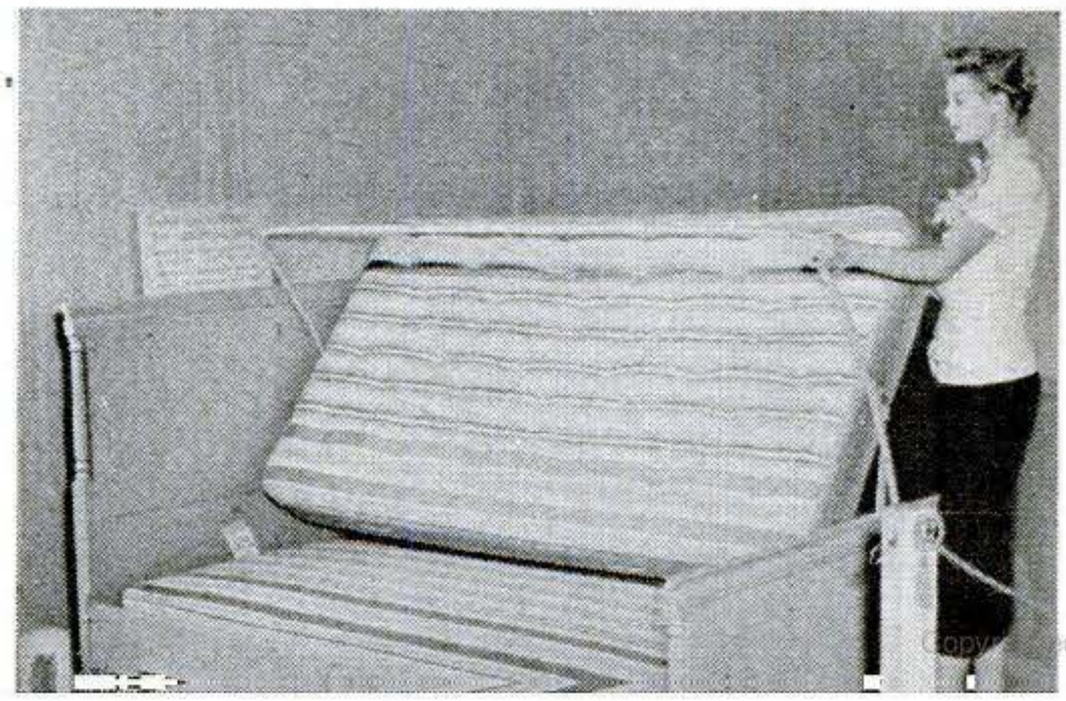
Next cut out the eight uprights. You might have to alter the 18½″ length shown in the drawing to suit the thickness of the mattress you'll use. The uprights should be high enough so the arms will clear the mattress by about ½″. If the cot has raised



ends, either cut them off or proportion the end uprights to clear them. Two uprights are screwed in place at right angles to each other on each corner. Drive 1¼″ screws from inside the frame. Nail or screw on the arms. If a tall person ever has to sleep on the cot, just lift off the complete frame. *—Thomas F. Donovan, Concord, N. H.*

Springs Provide Muscle for Turning Mattress

HOUSEWIVES who find it laborious to turn over a mattress will like this new device. A metal bar, ordinarily clamped along side of the bed, can be raised as shown at the right to a point where the mattress can be pivoted. Most of the lifting work is done by strong springs at the head and foot. American Mattress Turner Co., New York City, makes it to fit standard bed sizes.



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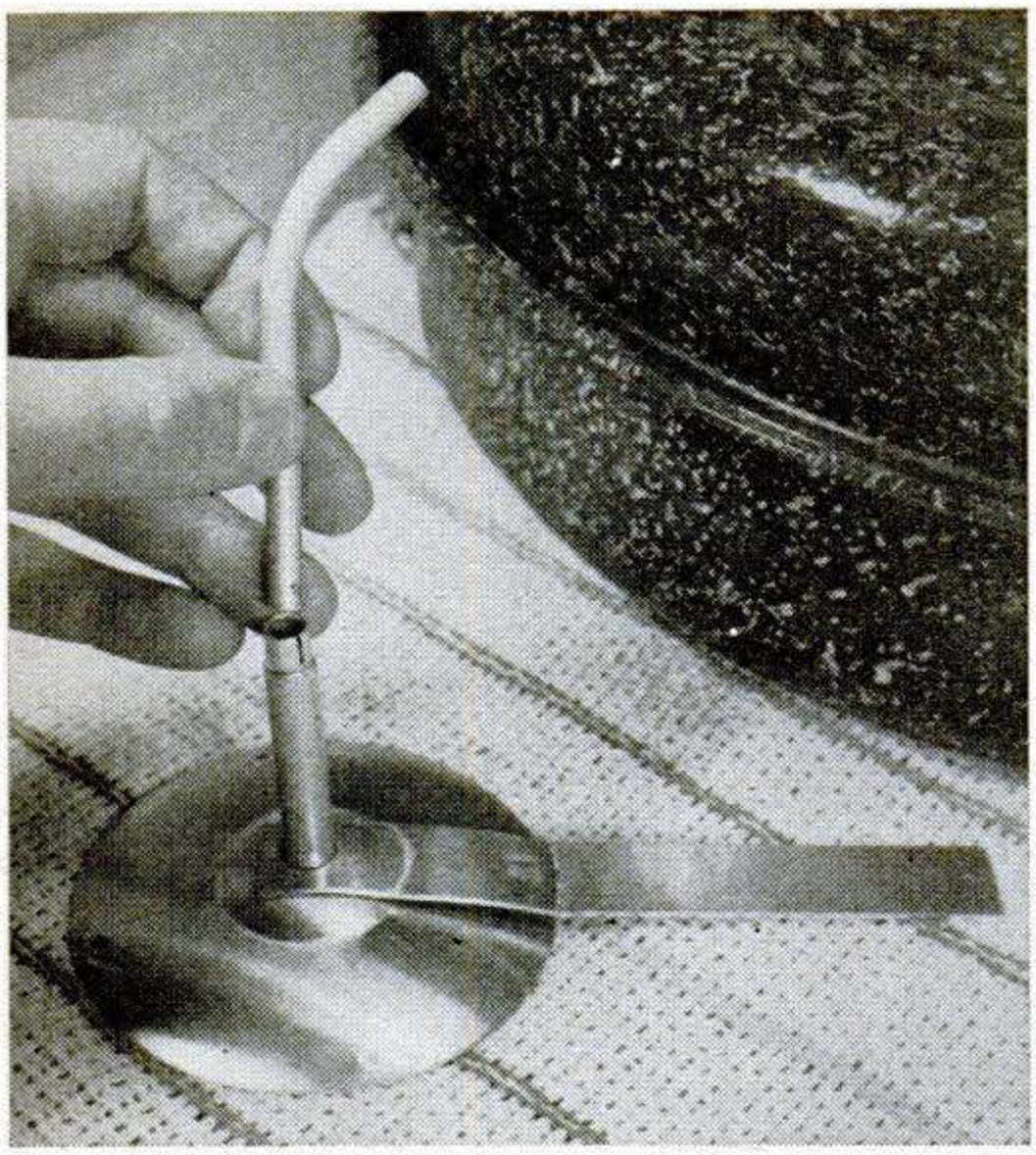
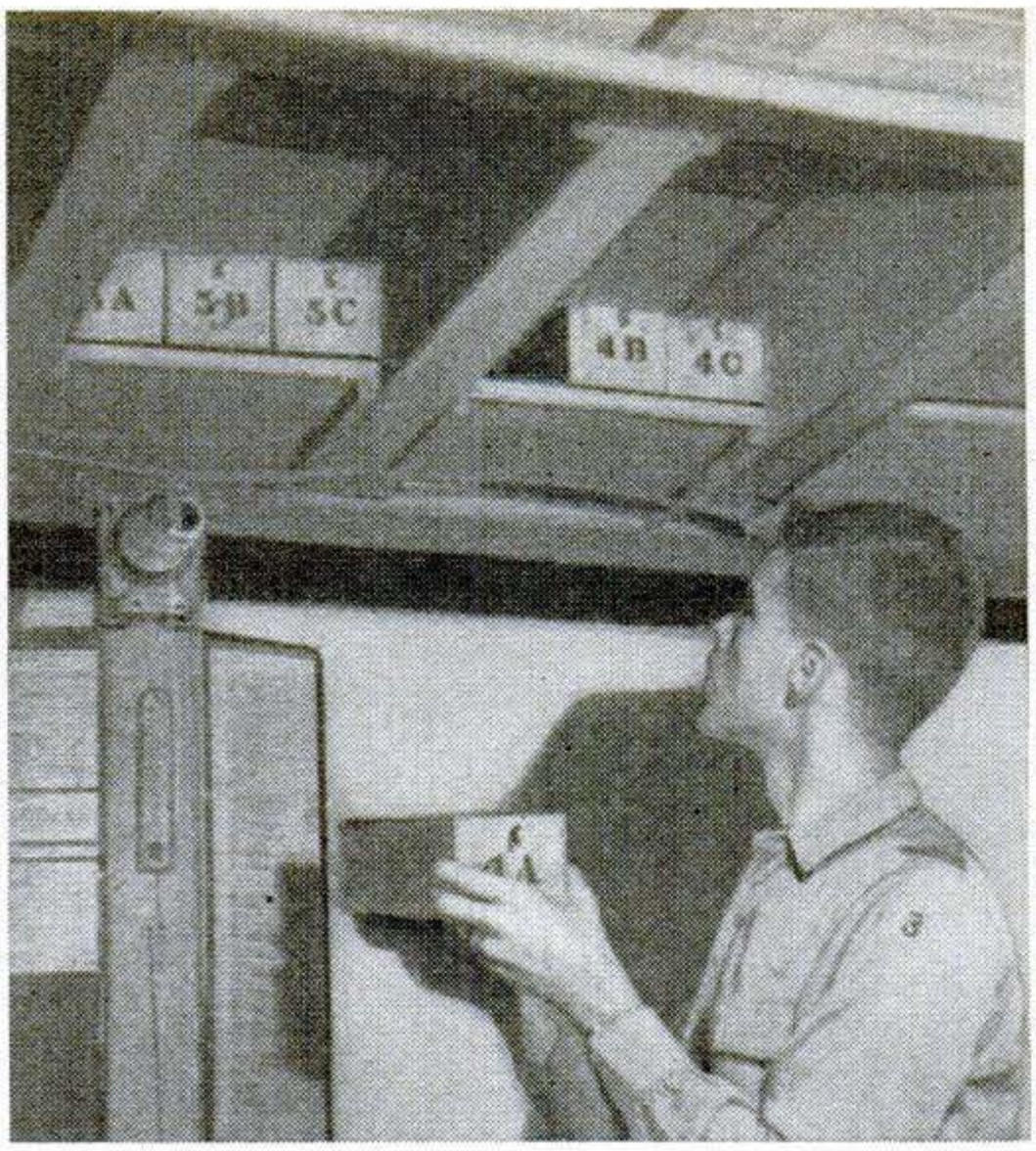


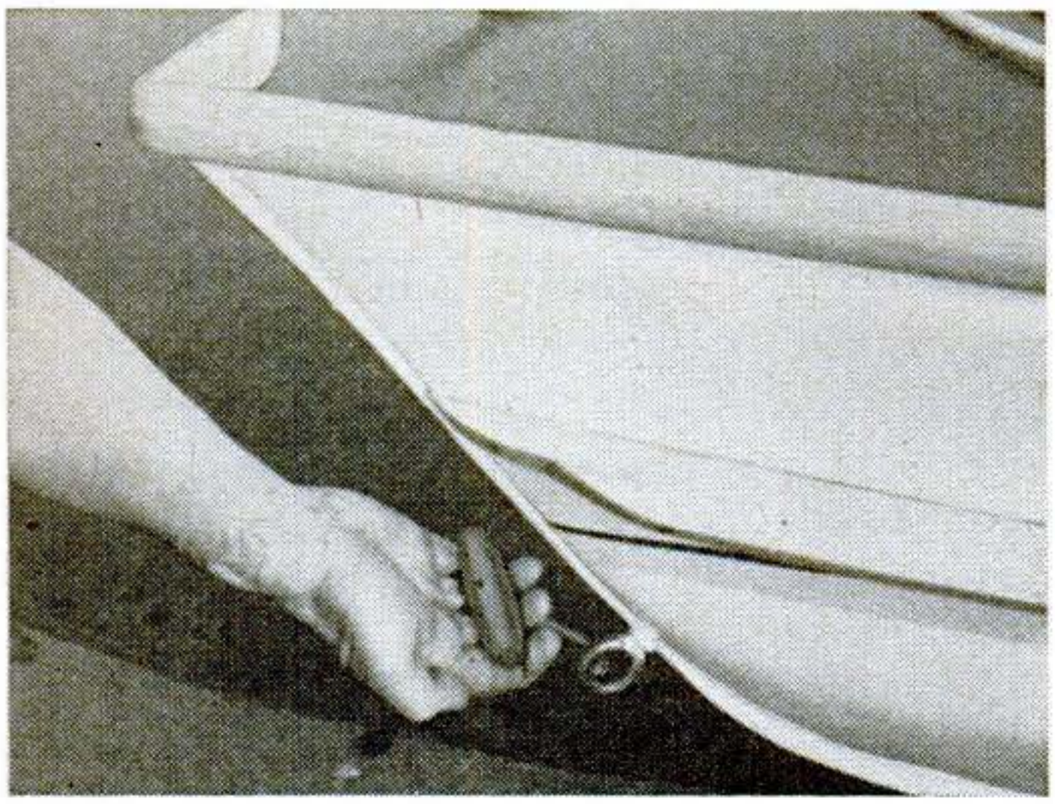
Bastes Meat Automatically

WORKING on the percolator principle, the Percomatic Baster® intermittently squirts fluid from the bottom of a roaster over meat being cooked. The four-piece unit, made by the Paul V. Shell Co., Kansas City, is placed on the bottom of the pan with the foot strap under the roast or fowl. Then liquid is poured into the pan to cover the base. Heat does the rest. The top tube is adjustable for height. Retail price is about 70 cents.



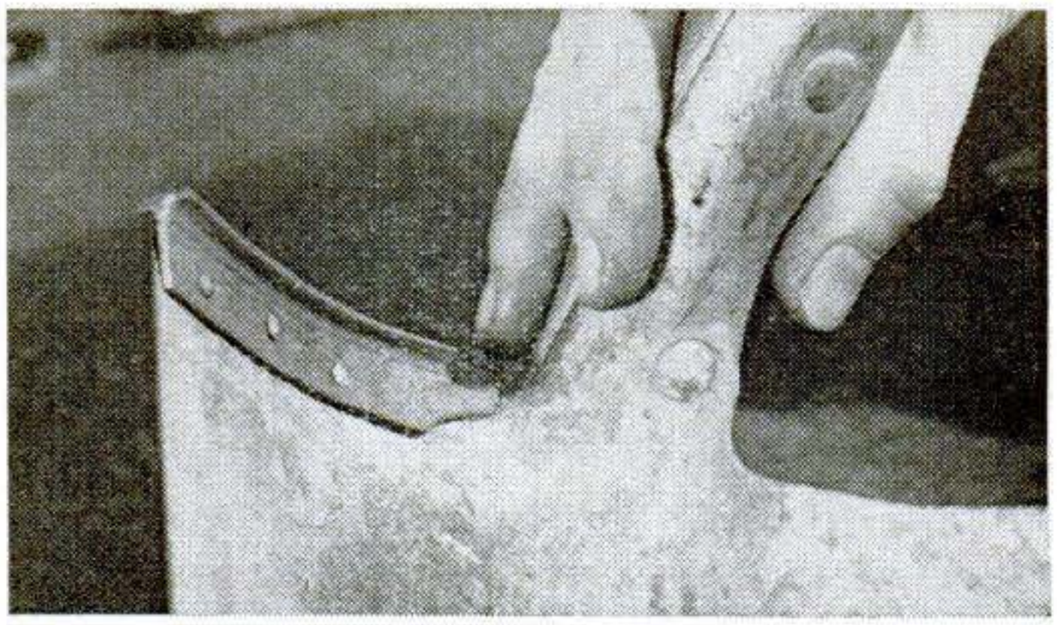
Joists Provide Storage Space

SHELVES built between the ceiling joists in my basement workshop provide additional storage space for small items. I use cheese boxes to hold the articles. The boxes are numbered and indexed, making it easy to find the desired object. This method of storage in otherwise wasted space provides a drier place than nearer the basement floor, and also keeps the articles from children. —*William R. Kern, Philadelphia.*



Hook Lifts Small Boat

FOR easy handling of the bow of my runabout, I made a small bale hook that fits in the towing eye on the stem. It's a short length of 5/16″ brass rod, bent as shown, and threaded on the straight end. A nut holds the rod to the handle. Such a hook is especially useful when the boat is fitted with detachable launching wheels (PS, July '49, p. 211).—*Clinton R. Hull, Costa Mesa, Calif.*



Footrest Eases Shoveling

PUSHING a shovel into the earth can become tiresome because of the sharpness of the edge on which your foot presses. A comfortable foothold may be made by riveting to the shovel edge a strip of T- or L-shaped metal as shown in the photo. I cut a piece from an old sled runner and bent it to match the contour of the shovel. Then it was clamped to the shovel while holes were drilled and the 3/16″ rivets installed. The bar is attached to the front of the shovel.—*Walter E. Burton, Akron, O.*

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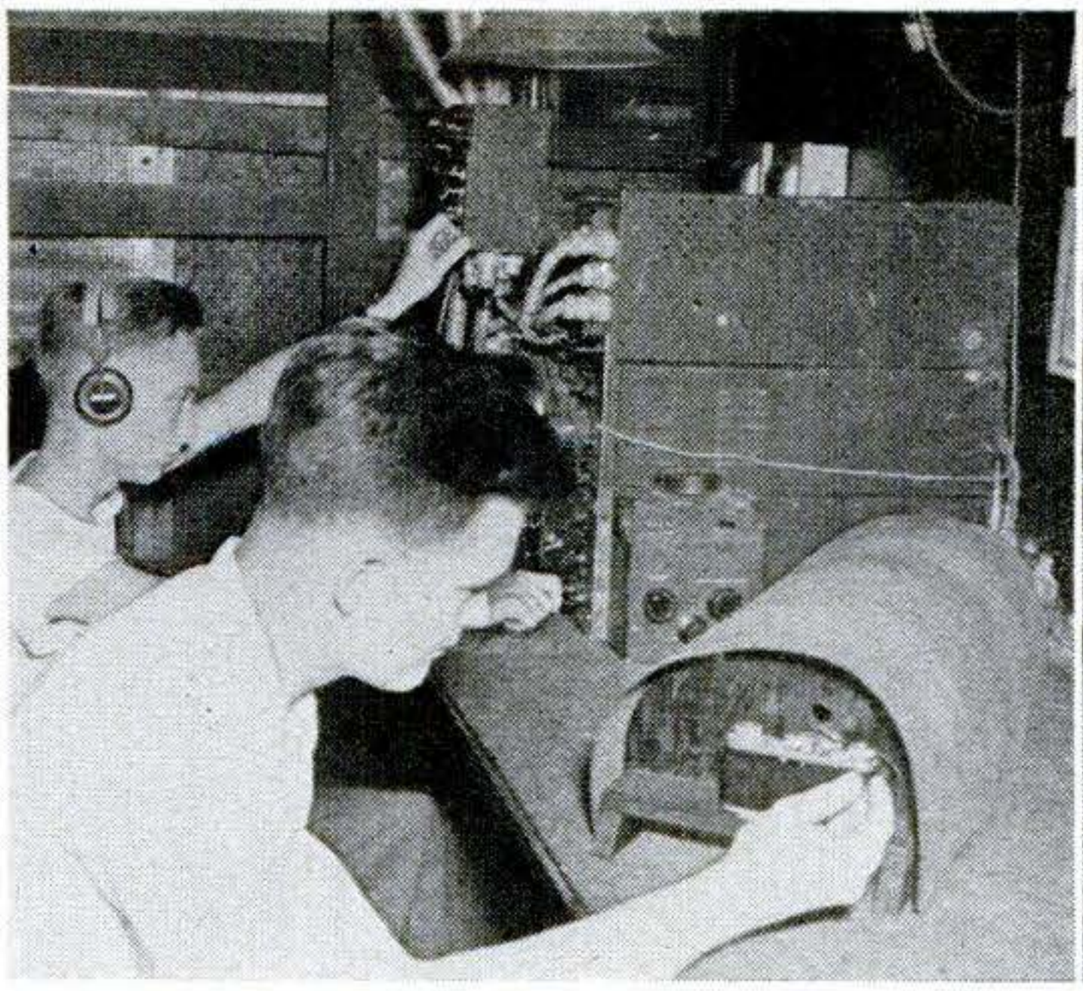


Photos are taken on the auxiliary scope, foreground, at five-minute intervals. Pictures tell time of rain and rate at which storm travels.

Plane used for seeding clouds carries tank of compressed carbon dioxide. The gas as well as solid dry ice has been used to induce rain.

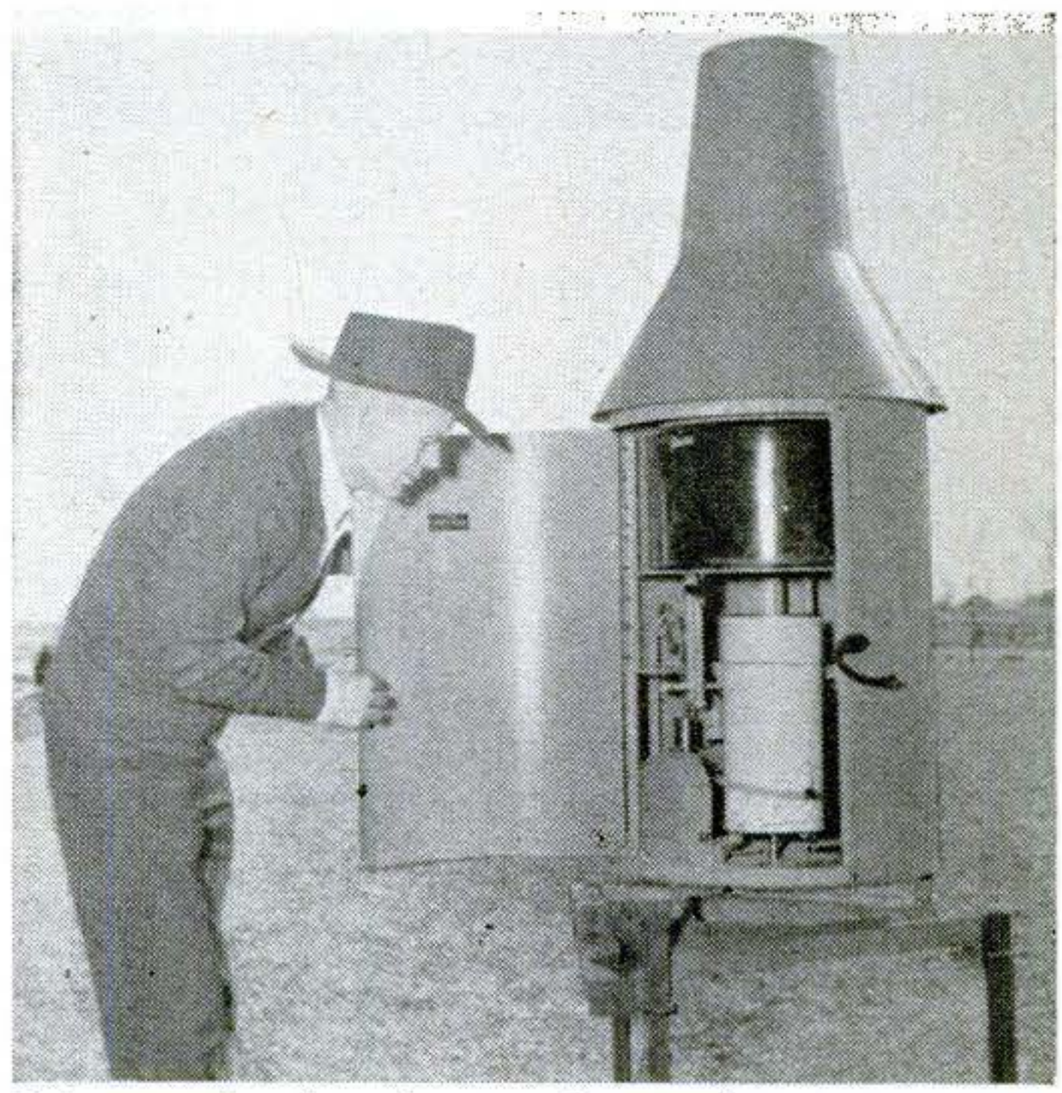
Radar Reads Rain Signs

WAR-SURPLUS radar equipment is playing a big part in the mechanization of farms in the El Paso, Illinois, area. Installed as part of an experiment in inducing rain artificially, the radar scope has shown that the course and speed of approach of rain clouds can be plotted very accurately.

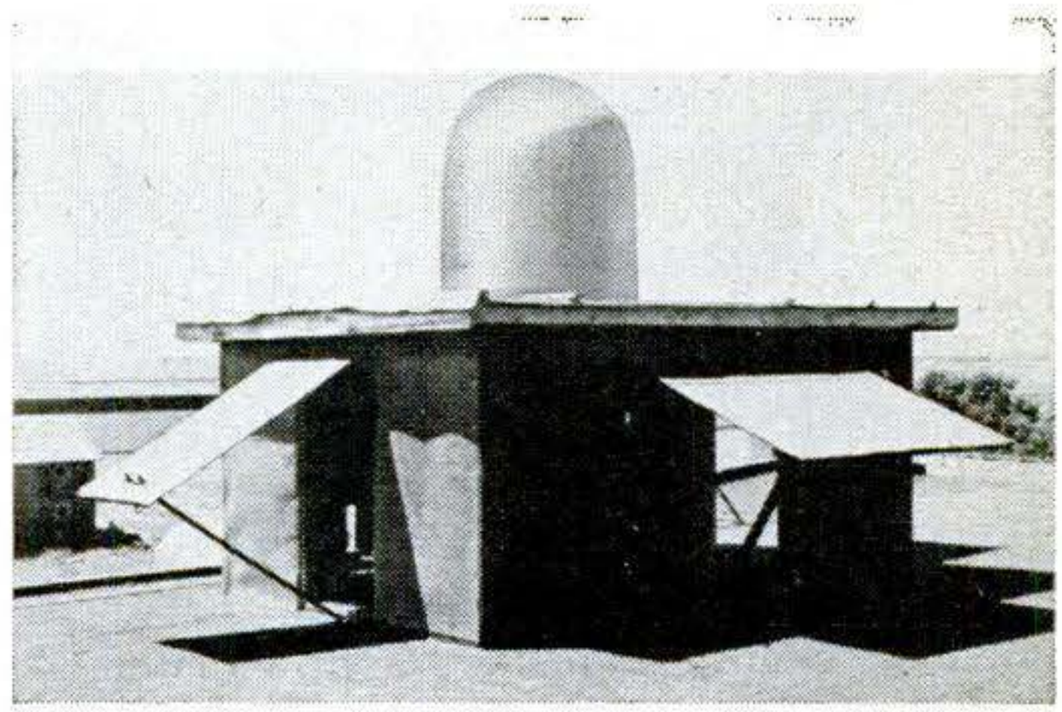
The experiment, being jointly conducted by the State Water Survey, Urbana, Ill., and the Pfister Hybrid Corn Company, of El Paso, uses the radar equipment to spot rain clouds up to 75 miles away. A plane carrying dry ice or carbon dioxide has plenty of time to get above the cloud and "seed" it at the place where rain is wanted.

The Pfister farm, one of the country's largest producers of hybrid corn seed, has thousands of acres in cultivation. As many as 1,500 workers are employed to harvest the crop, and the rain spotter has proved its value by giving advance warning of the approach of work-stopping rain.

Present plans call for using the radar set to get measurements of the amount of rainfall as well as the exact location of storms. This will be done by making photographic recordings on an auxiliary scope and checking the pictures against the information given by scores of water gauges located in the area of the experiment. Later, the gauges may be made unnecessary.



Pfister checks the reading of an automatic water gauge. Over 40 gauges are in use in the 376 sq. mi. area covered in the experiment.



Radar dome, enclosing the antenna, sits atop the roof of the radar room. The war-surplus equipment can "see" clouds up to 75 miles away.

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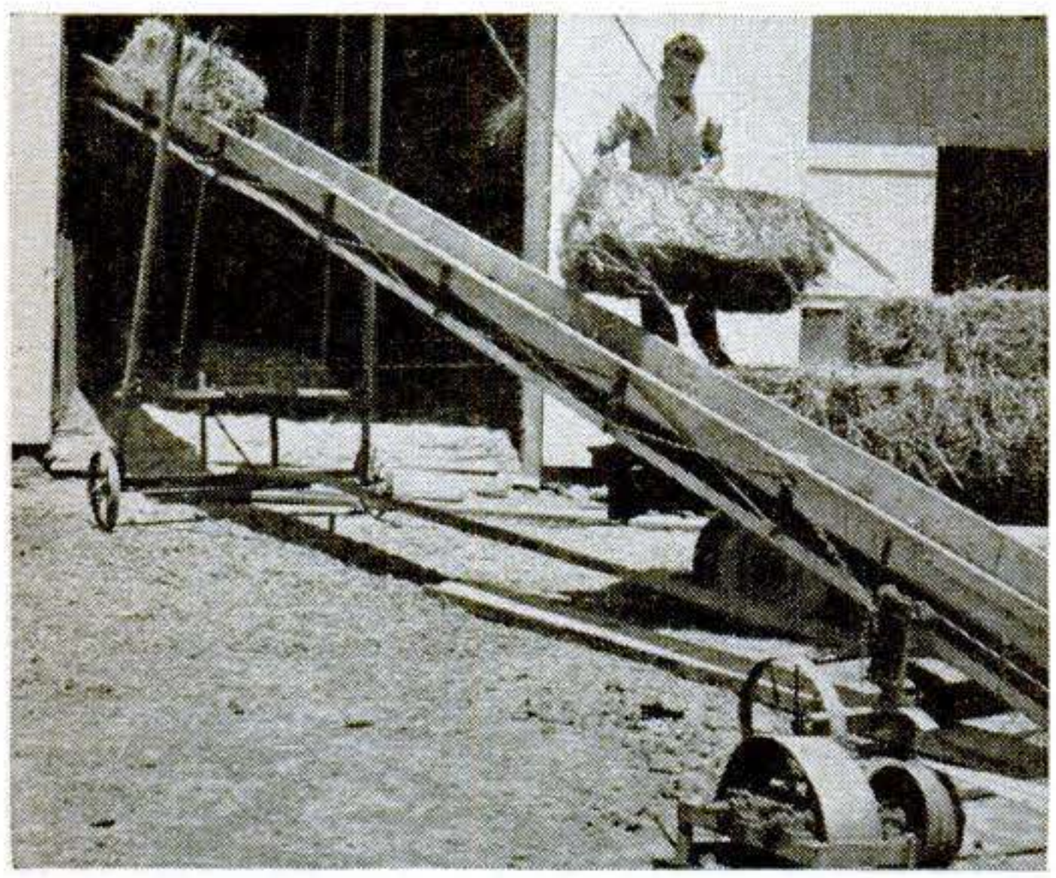
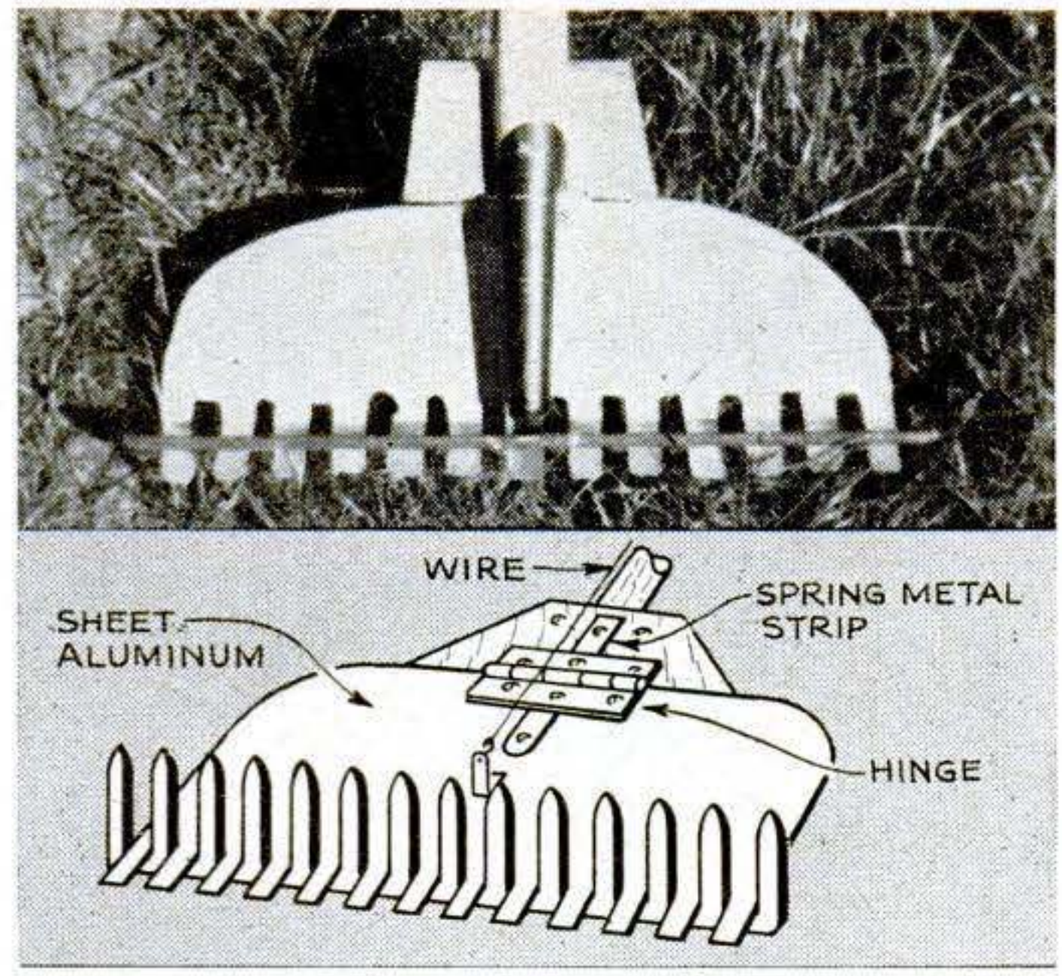
Electric Fence Is Portable

SITTING on top of the ground on crosspiece feet, these fence posts can quickly be set up or moved to a new location. Wire can be attached or removed without tools. The post is placed so that the slot in the insulator parallels the wire. Then the post is turned 90°, locking the wire in the plastic insulator. Made of heavy steel angle stock, the posts are enameled yellow. The maker is Portable Electric Fence Post Co., Graettinger, Ia.



Grain Elevator Loads Hay

ON THIS Iowa farm, a belt conveyor—ordinarily used to move grain—is also put to work transferring bales of hay from truck to barn. The bales are merely turned at an angle and dropped on the moving belt.

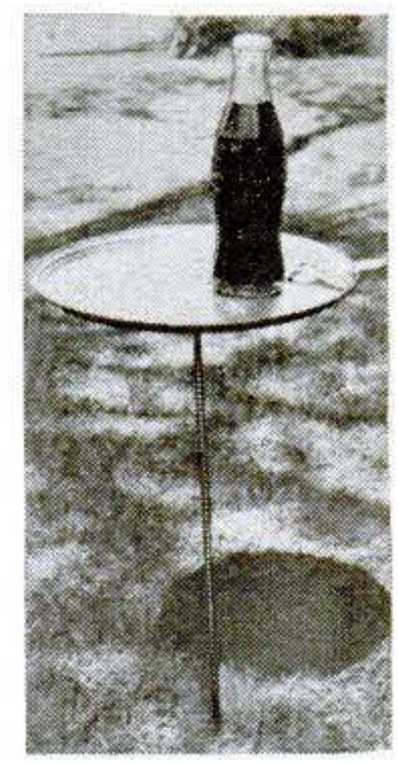


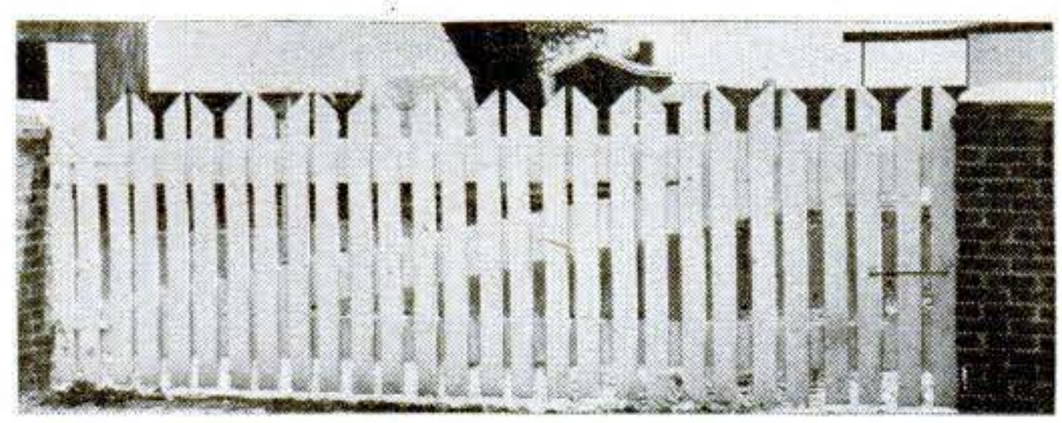
Rake Unloads Its Leaves

PULLING a wire at the top of this rake's handle scrapes leaves and trash off the teeth. To make it, notch one edge of a sheet of aluminum to suit your rake. Mount it as shown, using a piece of spring steel and a butt hinge. The wire is attached to an angle iron riveted to the aluminum.—*William Wiesler, St. Louis, Mo.*

Rod Supports Garden Tray

A METAL disk about 1′ in diameter—a heavy aluminum pie pan will do—and a ¼″ iron rod at least 2′ long made this tray. Drill a hole in the center of the disk. Thread one end of the rod and sharpen the other for sticking in the ground. Washers and nuts threaded on the rod hold the tray.—*Will Stoll, Elmhurst, Ill.*





Farm Gate Is Ornamental

BESIDES improving the appearance of a farm, a barnyard gate of this type is "stock tight." The closely spaced pickets keep in pigs or chickens should they escape from their pens.—*A. M. Wettach, Mt. Pleasant, Ia.*

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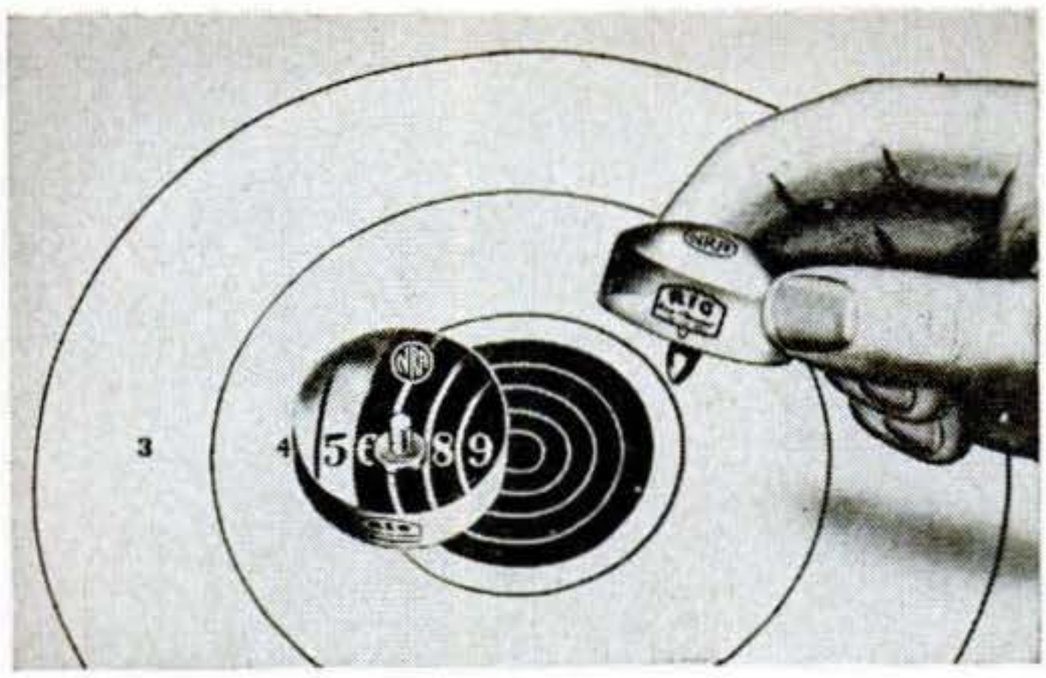
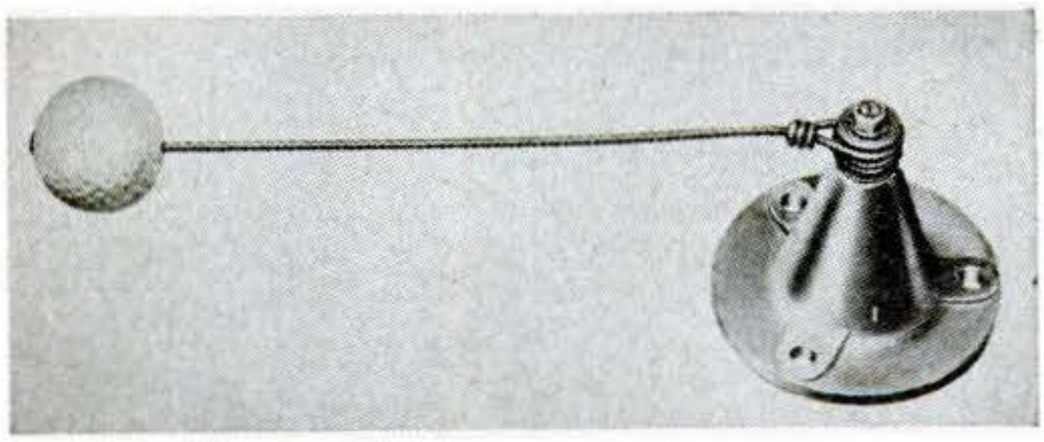


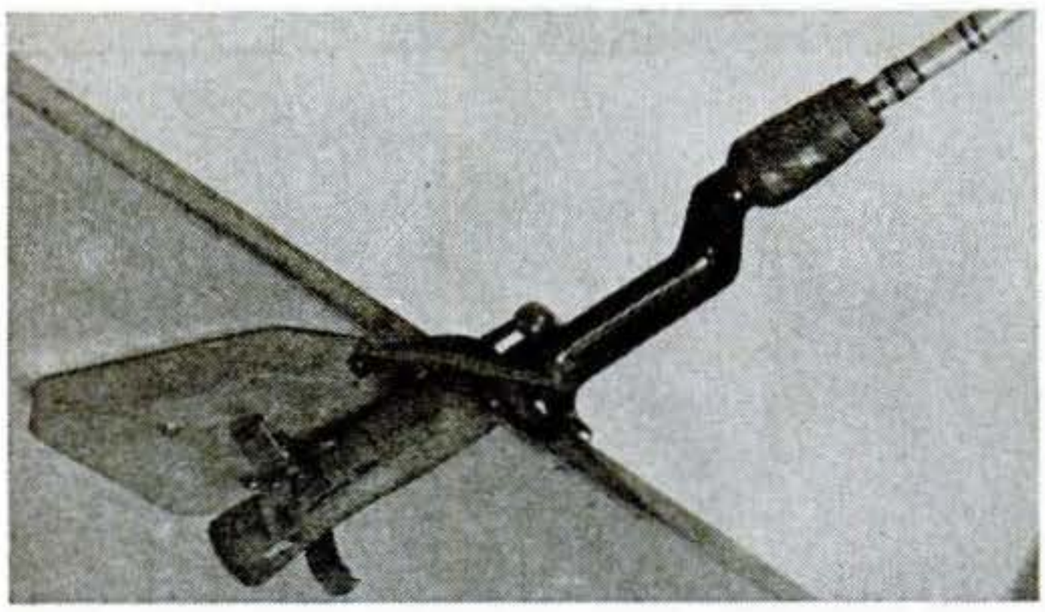
Target Scorer Ends Disputes

THERE'D be fewer arguments over rifle scores with this Eze-Scorer®, a simulated bullet in a plastic magnifier. Inserted in a bullet hole, it enlarges your view of target area so that the close scores become more readable. It comes in .22, .38, and .45 calibers.



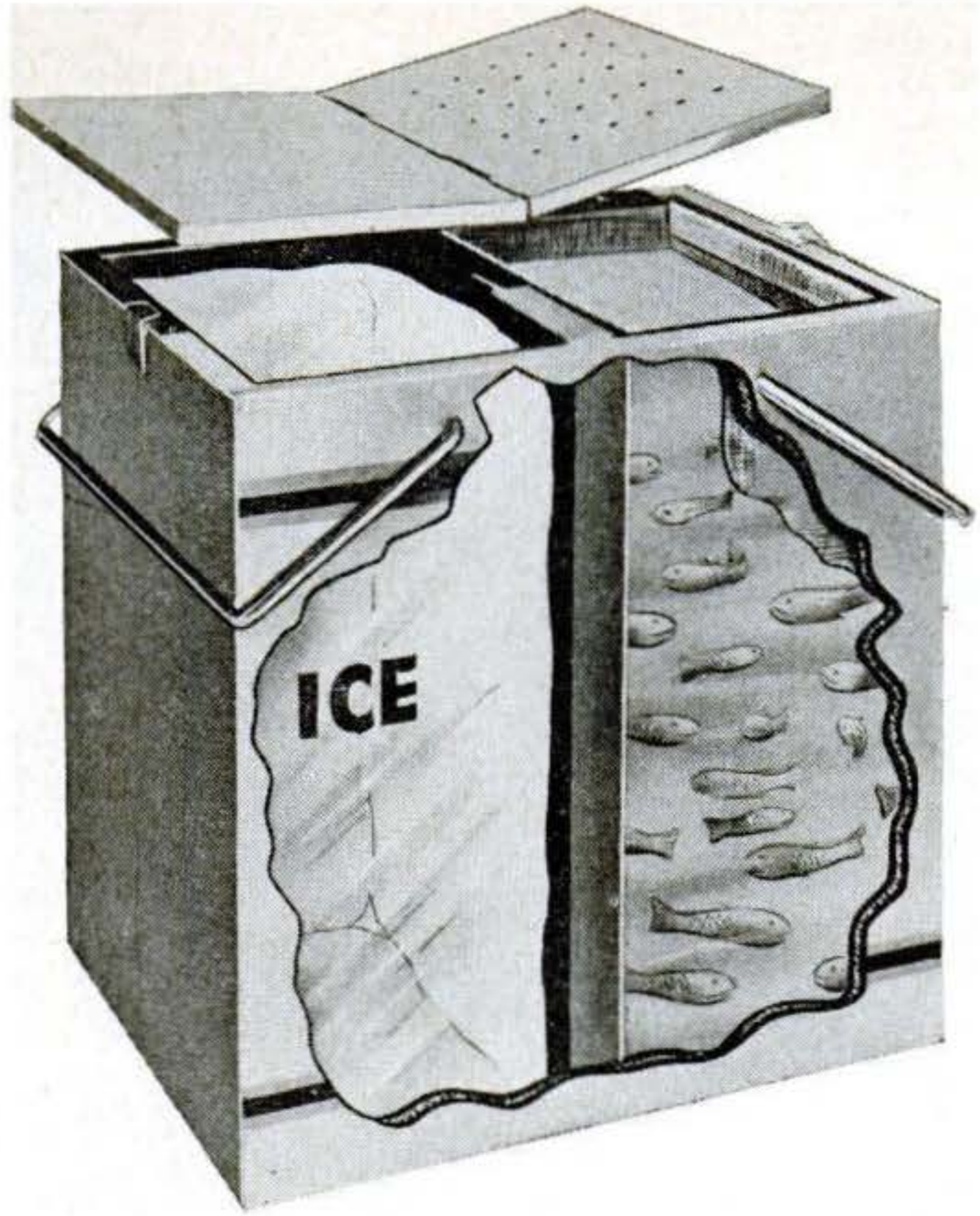
Golf Ball Goes Nowhere

YOU can improve your golf swing without teeing up or chasing balls with this practice device. Made by Taylor Products, of Detroit, it consists of a ball on the end of a spring-steel arm that spins around on a ball-bearing spindle when the ball is hit.



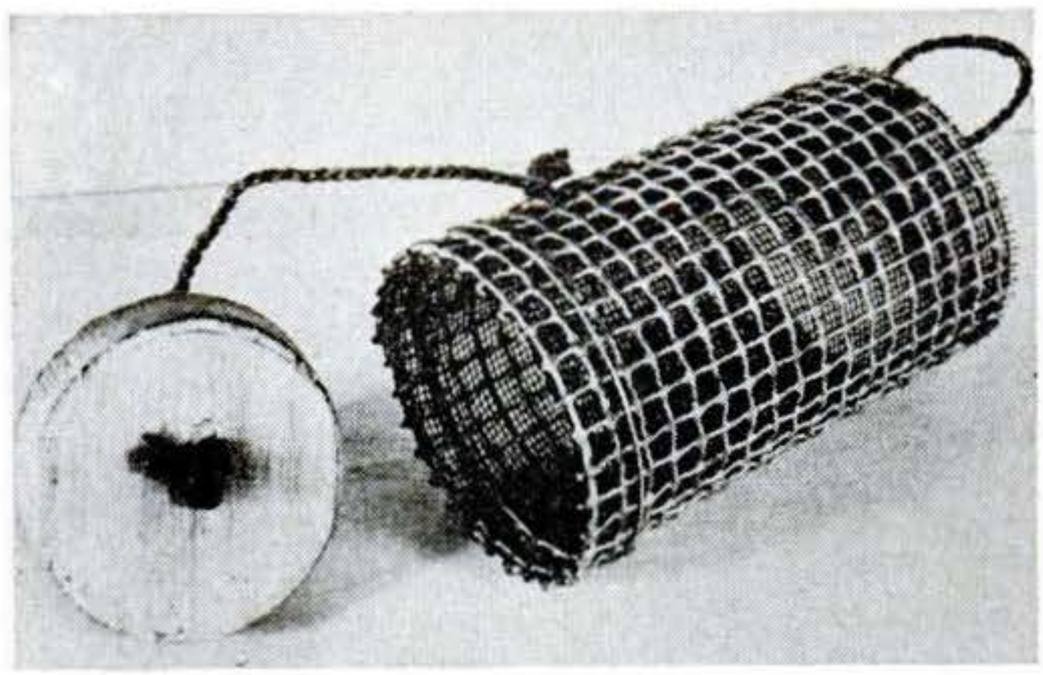
Pole Holder Fits Boat Seat

THIS new fishing-pole holder keeps the pole within quick reach of the fisherman as he rows the boat. Unlike most holders, which clamp on the stern, this fits under the seat, holding the upper part of the pole's handle in a rubber ring while the lower part clamps into a spring clip. It is manufactured by W. J. Peterson, of Akron, N. Y.



Ice Box Keeps Minnows Alive

FISHERMEN, long faced with the problem of keeping minnows alive for bait, can keep them happy and healthy for weeks in this new Ful-O-Life® refrigerated minnow box. One side is a tank for the minnows, while the other holds a cake of ice. The ice keeps the water cooled to a point where it retains the oxygen required by the minnows to live.



New Bait Lures Lobsters

FILLED with only two ounces of Lob-Lure®, a new artificial lobster bait, this small, 6-inch-long basket is all that's needed to replace the five pounds of dead and decaying fish normally required to lure a lobster. Under water, the bait, which comes in putty form, slowly dissolves, attracting the lobster to the trap. The noncorrosive, easily cleaned, plastic-and-metal-mesh container is made by the Chicopee Manufacturing Corp.

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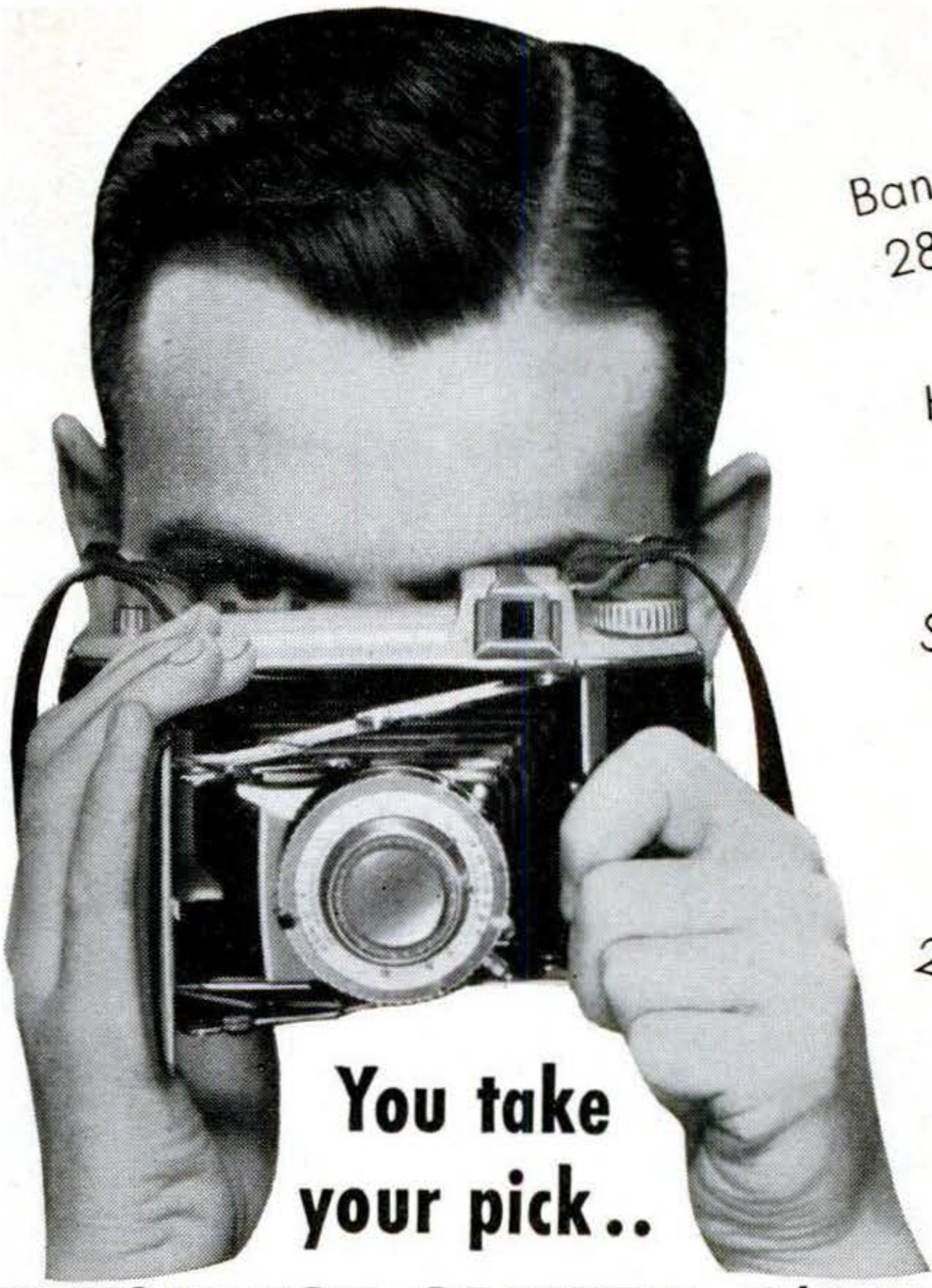
Kodachrome slides

Kodacolor snapshots

Kodak Ektachrome transparencies

Black-and-white negatives



Bantam (828) 28 x 40mm.

Half-620 1⅝ x 2¼

Square 620 2¼ x 2¼

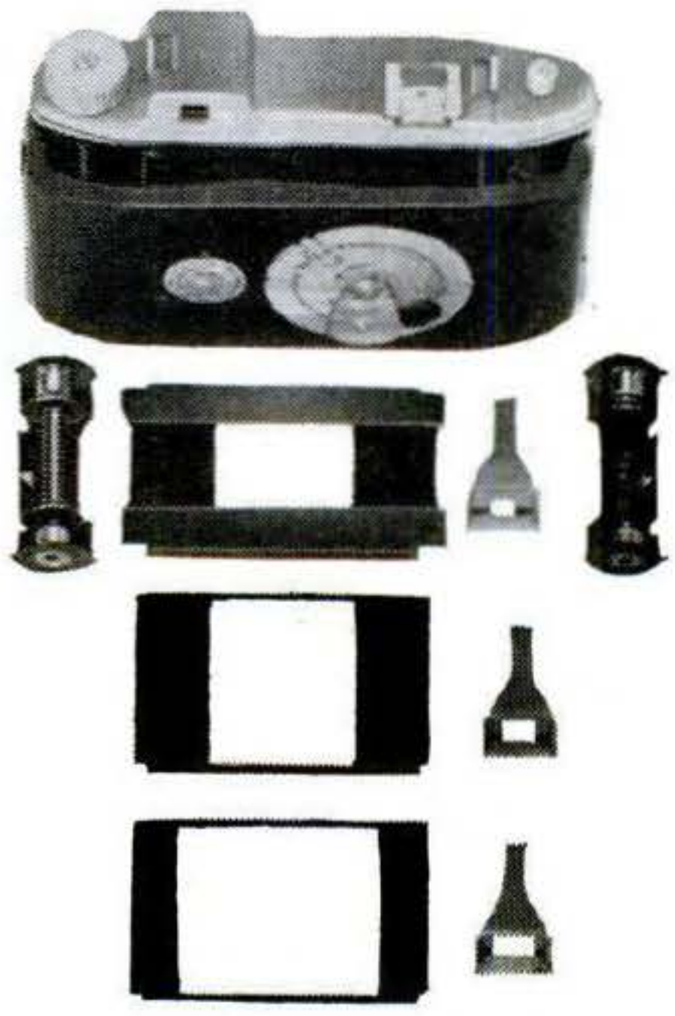
Full 620 2¼ x 3¼

with KODAK TOURIST CAMERA f/4.5 or f/6.3

and new Adapter Kit with interchangeable back and masks

Change-over is quick and easy . . . slip on adapter back, add masks for negative and view finder; for 828 film, add spool baskets as well. Adjust picture-size guide on adapter back. Now you're all set for your choice of a variety of films and kinds of pictures, including miniature Kodachrome slides.

Enjoy other new camera features ...shutter release set into camera bed; brilliant view finder; built-in exposure guide. Kodak Tourist Adapter Kit, $14.50, fits these models: Kodak Tourist Camera with *f*/4.5 lens, $71; with *f*/6.3 lens, $47.50. Prices include Federal Tax. At your dealer's.



SPECIAL BACK . . . without accessories, gives full 2¼ x 3¼ size... 8 shots on black-and-white Kodak 620 Film; 6 on Kodak Ektachrome or Kodacolor Film.

BANTAM ASSEMBLY . . . (28 x 40mm.) . . . 8 shots on black-and-white Kodak 828 Films or Kodachrome Film.

1⅝ x 2¼ MASKS . . . 16 shots on black-and-white Kodak 620 Films, 12 on Kodak Ektachrome or Kodacolor Film.

2¼ x 2¼ MASKS . . . 12 shots on black-and-white Kodak 620 Films, 9 on Kodak Ektachrome or Kodacolor Film.

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To MAKE NEW FRIENDS FOR HOLIDAY

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$3.50 VALUE *only* 50¢ *plus* the inside paper wrapper from 12 tins of Holiday Pipe Tobacco.

Offer limited to U.S.A. Expires Nov. 30, 1949

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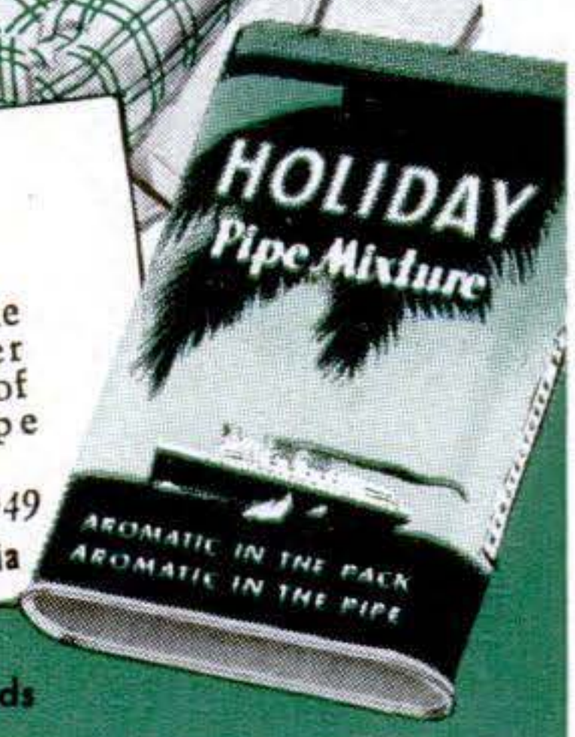

Also in vacuum pounds

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AROMATIC PIPE MIXTURE

Enjoy that real Holiday feeling 365 days a year with HOLIDAY—the aromatic High Grade pipe mixture—at a popular price. Only 15 cents!

AN ADVENTURE IN GOOD SMOKING

"But I always carry Weldwood Glue; it's wonderful for emergencies."

Remember Weldwood Glue when you need dependable wood-to-wood bonds. Quick and easy to mix with cold water . . . tremendously strong . . . stain-free . . . rot-proof . . . and *permanent*. At paint, hardware, variety stores and lumber yards. 15¢, 35¢, 65¢, 95¢ and larger sizes.

WELDWOOD PLASTIC RESIN GLUE

United States Plywood Corporation, New York 18, N. Y.

ALSO HANDY FOR WOOD HOBBYISTS!

Firzite

— to give you smooth finishes on fir plywood and other soft woods.

A pre-finishing material that seals the wood pores... tames the wild grain . . . virtually eliminates checking and grain raising. An excellent base for stain, paint or enamel. White or clear. White Firzite provides an easy, low-cost way to achieve "blond," "bleached" or "wiped" finishes.

Satinlac

— to preserve the beauty of all woods.

An inexpensive coating for the proper finishing of Weldwood Hardwood Plywood and similar woods. Clear. No brush marks. Brings out all the natural beauty of wood. Does not yellow or darken with age.

FIRZITE and SATINLAC are available from paint, hardware and lumber dealers. Write for leaflet No. 3 on finishing plywood.

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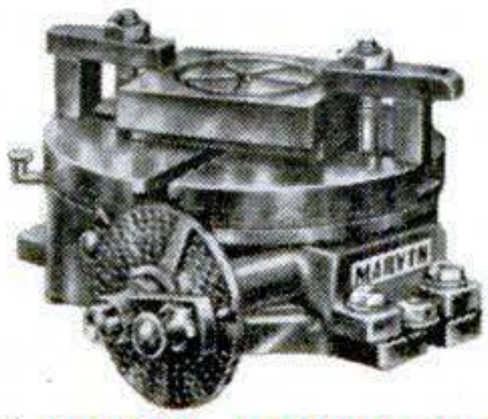
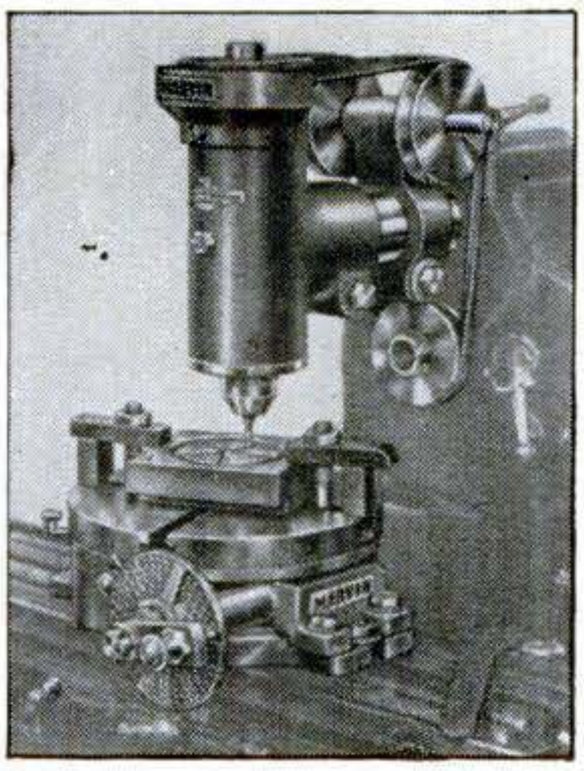
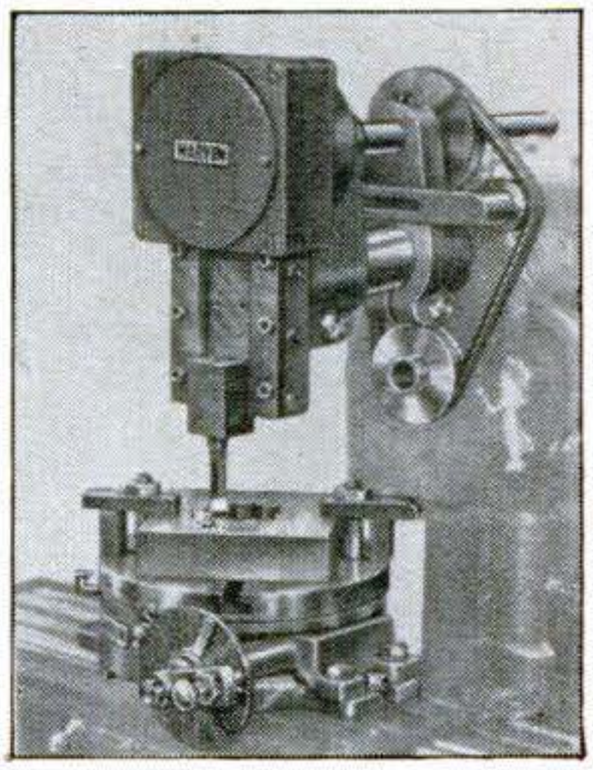
MARVIN *Presents*

• *The* MARVIN VERTICAL MILL ATTACHMENT • MARVIN ROTARY TABLE • MARVIN SLOTTING ATTACHMENT



The new 6" MARVIN ROTARY TABLE for your ATLAS BENCH MILL or Shaper. Locks from the bottom to prevent tilting . . . 3 index plates, 6 sets of holes each . . . hand wheel, worm hardened and ground. All castings are iron. *Extremely rigid*. No. R-1102 $93.00.





The new VERTICAL MILL ATTACHMENT for ATLAS BENCH MILLS. Can be attached to the spindle of your mill in 3 *minutes*. The head can be set at an angle or pulled out past the travel of the table for overhanging work. No. V-1200 $65.00.

The new SLOTTING ATTACHMENT for ATLAS BENCH MILLS. This tool simplifies many awkward jobs. Makes squared holes, dies, splines, and internal key seats. Operates quietly and smoothly, *a most efficient tool for you to own*. No. S-1070 $82.00.

Now . . . for the first time . . . you can increase the versatility of your ATLAS BENCH MILL 400%. MARVIN ATTACHMENTS can be attached to your mill in 3 *minutes*. Ideal tools for the HOBBYIST but a necessity for PRODUCTION PLANTS.

LOWER YOUR PRODUCTION COSTS to meet today's competition, LOWER YOUR SELLING PRICE to meet today's demand for lower prices. The MARVIN BENCH MILL ATTACHMENTS are the *answer* to your production and marketing problems. Write now for complete information. All prices quoted F.O.B. Canton, Ohio.

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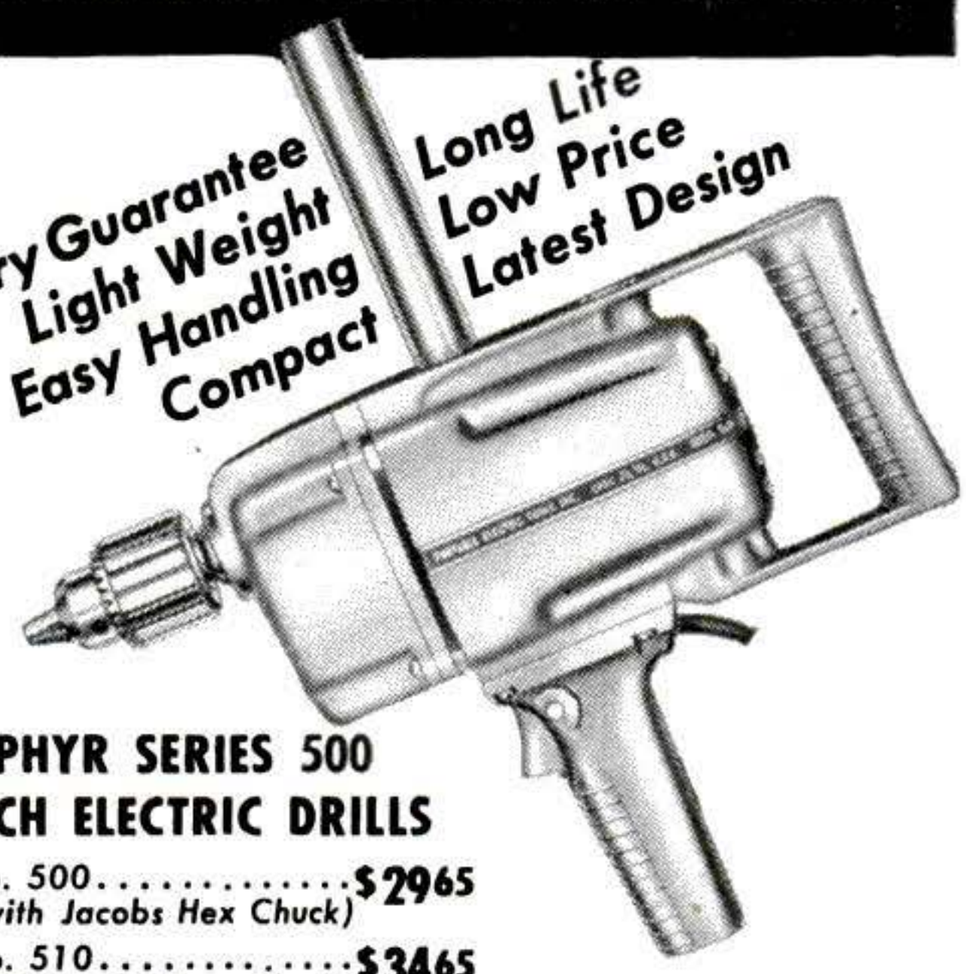
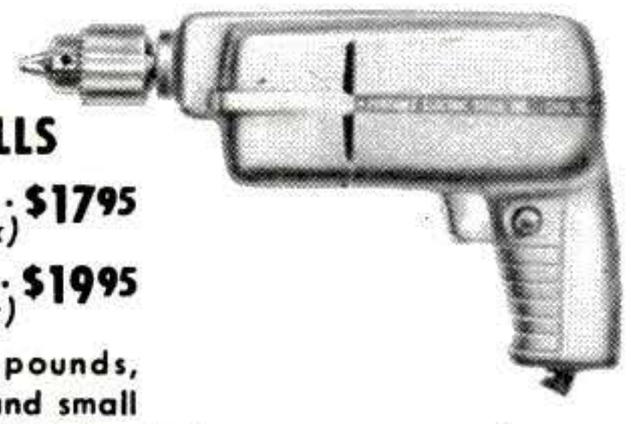


ZEPHYR SERIES 500
½-INCH ELECTRIC DRILLS

Model No. 500 ..... **$29.65**
(with Jacobs Hex Chuck)

Model No. 510 ..... **$34.65**
(with Jacobs Gear Chuck)

Full ½-inch drill capacity; removable side handle for close-quarter drilling; weight complete only 9 pounds. U. L. listed.



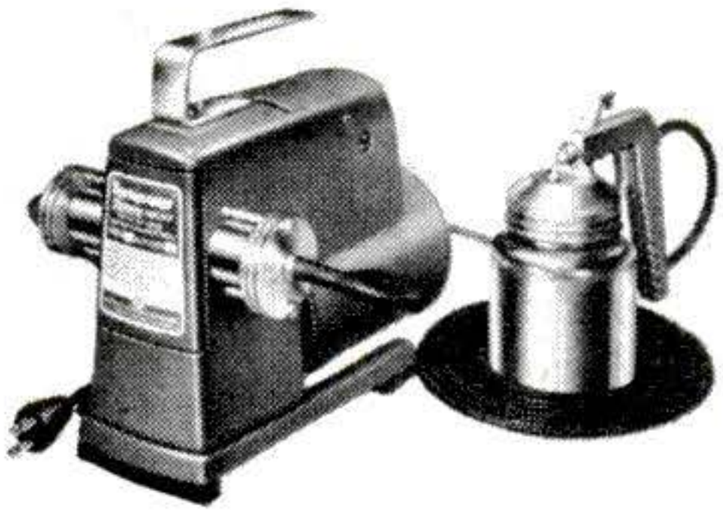
ZEPHYR SERIES 1950
¼-INCH ELECTRIC DRILLS

Model No. 1950-H **$17.95**
(with Jacobs Hand-Tite Chuck)

Model No. 1950-G **$19.95**
(with Jacobs Gear Chuck)

Weight complete, only 3 pounds, 2 ounces. The speed, power, and small size make it the ideal power tool; handy to use as source of power for driving drill attachments for disc sanding and polishing, cleaning paint brushes, grinding and sharpening tools, buffing, removing rust and paint with wire wheel brushes, etc. A real money saver around the house, farm and home shop. U. L. listed.

SPRAYMASTER ZEPHYR MODEL SM-25 $24.95



A complete electric sprayer unit with electric motor, two-cylinder air compressor, pressure equalizer storage tank, 25 to 30 pounds pressure. Sprays paint, enamel, lacquer, insecticides, and mothproofing solutions. Easy to use—no spraying experience necessary for fine job on furniture, cars, radiators, etc. Full instructions with every unit.

See these tools at your dealer, or write direct for full information. Dealer inquiries invited.

GET THIS FREE BOOKLET—16 pages of detail information on Portable's complete line of top-value electric tools, tool kits, and work-saving attachments.

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ALWAYS JUST THE RIGHT CHOKE

MODEL #185D
20-gauge, 3-shot repeater, with 3 interchangeable choke tubes—Full, Modified and Improved Cylinder.
"3 guns in one."
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.410 gauge, 3-shot repeater, with 2 interchangeable choke tubes — Full and Modified.
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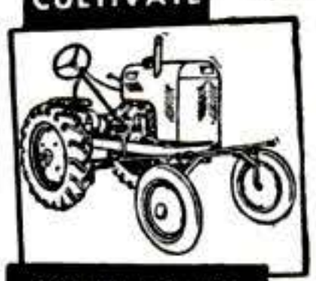
SHAW "DU-ALL" and "PEPPY PAL" TRACTORS

PLOW

CULTIVATE



These rugged walking or riding tractors are ideal for farm, truck garden, orchard, poultry farm. Operate on a few cents an hour. A child can handle them.

DO DOZENS OF JOBS Both riding and walking tractors quickly and easily plow, cultivate, harrow, disk, bulldoze, spray, haul, grind, saw wood, etc.

LOW FACTORY PRICES Buy direct or thru your dealer. Year's guarantee.

RIDING TRACTORS Four models from 5 to 12½ H. P., 58 in. wheelbase, 36 to 52 in. wide, 24 in. plant clearance, Hand or electric starter. Walking Tractors 1½ to 5 H.P.

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State Fair of Louisiana
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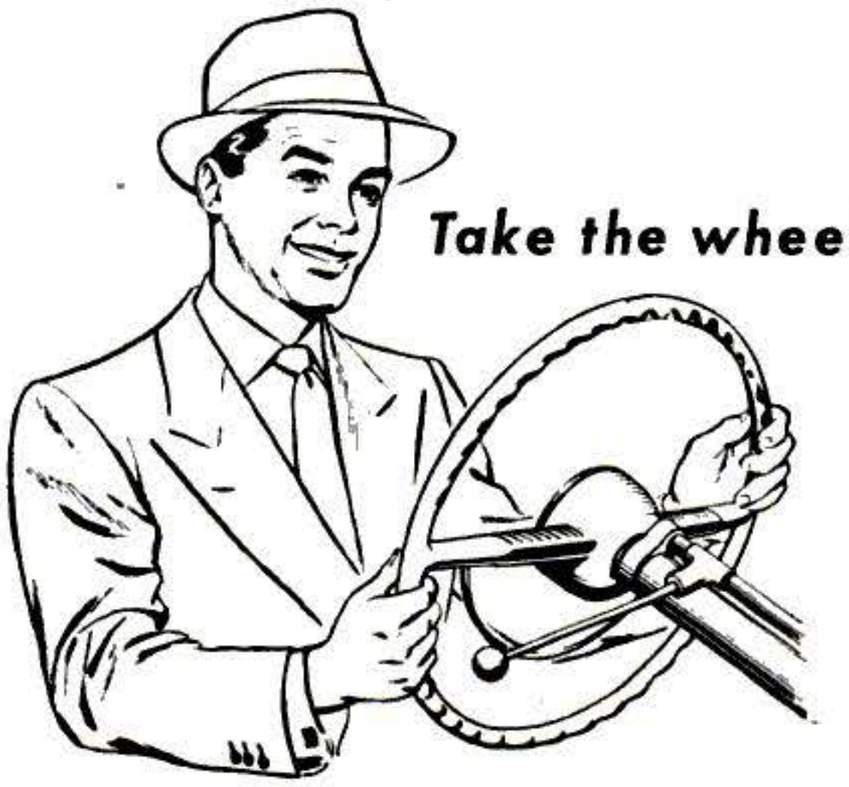
A Straight Steer About the NEW FORD "FEEL"

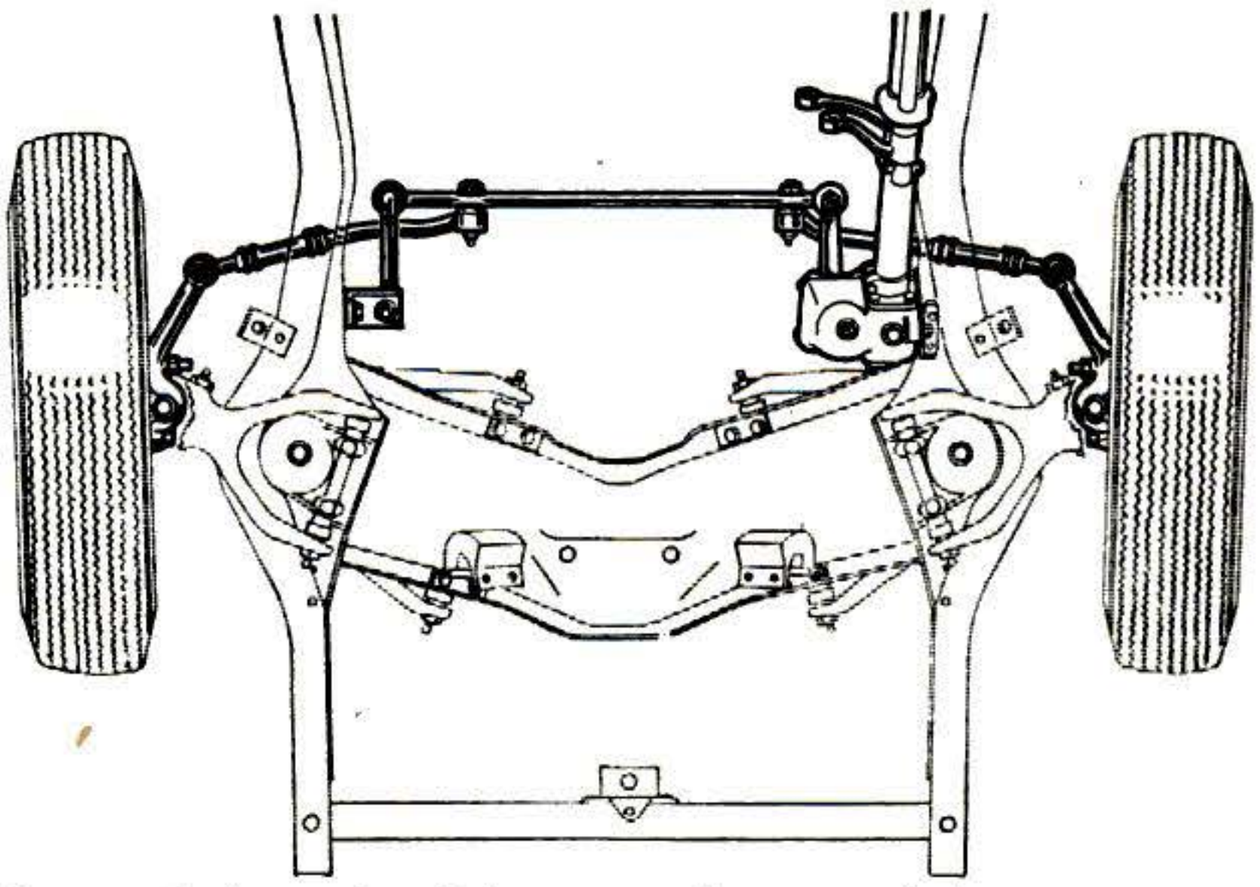


Take the wheel...

. . . of the '49 Ford and you'll sense in a minute that here's a new "feel" in driving. That's because, for one thing, the '49 Ford has practically effortless "Finger-Tip" Steering—a new, symmetrical steering linkage combined with new independent front wheel suspension and extra-large worm and roller type steering gear. Either wheel is free to move up and down without affecting steering. Pitman and idler arms are of equal length and parallel. Tie-rods and lower control arms move through similar arcs to preserve steering accuracy at all times.

And the precision-built steering gear uses a large triple-tooth roller, mounted on two sets of needle bearings, to eliminate sliding friction. Steering ratio is increased nearly 10% for even easier steering control.

Yet Ford's "Finger-Tip" Steering is only one of the many advancements that combine to produce the new Ford "Feel"—the "Feel" that drivers acclaim as being revolutionary in the field.



Symmetrical steering linkage permits up and down wheel movement without affecting steering accuracy.

In flashing performance . . . solid roadability . . . and reassuring security, too, the '49 Ford has literally brought a new "feel" to driving. Now—today—take the wheel and try the new Ford "Feel."

White sidewall tires, optional at extra cost

There's a NEW Ford in your future

Awarded the Fashion Academy Gold Medal as the "Fashion Car of the Year"

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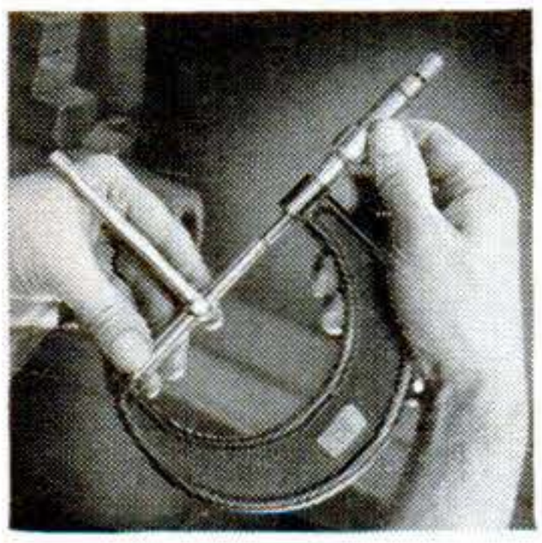
MECHANICS!

TWO companion tools for taking quick, accurate, inside measurements

LUFKIN TELESCOPING GAGE

An exclusive design feature is the double telescoping action of the plungers. As a result, the handle is always centered giving perfect balance and "feel" so essential to accuracy



Measurements down to one thousandth inch or less are taken from the gage with a Micrometer.

Available individually or in sets. Range 5/16 to 6 inches. Each gage has its own handle sized in direct proportion to its plunger range, assuring perfect balance found in no similar gage.

THE LUFKIN SMALL HOLE GAGE

Ideal companion tool for measuring small holes or slots below the 5/16 inch range of the Telescoping Gage. Simply insert ball end in hole—turn knurled knob until right "feel" is obtained—then measure ball end with Micrometer. Available individually in four different sizes, or as a complete set with range of 1/8 to 1/2 inch.

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FOR AS LITTLE AS **$3.95** POSTPAID

32 DRAWERS ALL METAL $8.95 POSTPAID

DRAWERS

Uniform in all chests are 1¼" deep, 2¾" wide, 5¾" long. 1-piece aluminum units have removable dividers to make 3 bins, index cards on front. Kraft-board drawers have metal pull tabs.

YOUR MONEY BACK if you are not satisfied with your HANDI-CHEST

NOW with three times the "bins," HANDI-CHEST is a must for home, office, shop. Ideal kit for small parts, hobby needs, sewing, fishing, etc. Steel spot-welded cabinets, metal drawer guides, pleasing grey finish, rubber feet that won't mar any surface. Aluminum or Kraft-board drawers. Manufacturer ships promptly, direct, postpaid. Send check or money order. No C.O.D., please. Ohio orders add 3% sales tax. Ask about quantity discounts.

16 drawers — Steel Cabinet is 6" deep, 8¼" high, 12⅝" wide. 48 compartments in aluminum drawers. Model 16A HANDI-CHEST complete **4.95**

Model 16K HANDI-CHEST, same size as above, with heavy Kraft-board drawers, metal pull tabs, complete **3.95**

32 drawers — Steel Cabinet is 6" deep, 15¼" high, 12⅝" wide. 96 compartments in aluminum drawers. Model 32A HANDI-CHEST complete **8.95**

Model 32K HANDI-CHEST, identical in size, with heavy Kraft-board drawers, metal pull tabs, complete..... **5.95**

64 drawers — Steel Cabinet is 6" deep, 15¼" high, 24½" wide. 192 compartments, aluminum drawers. Model 64A HANDI-CHEST complete **15.95**

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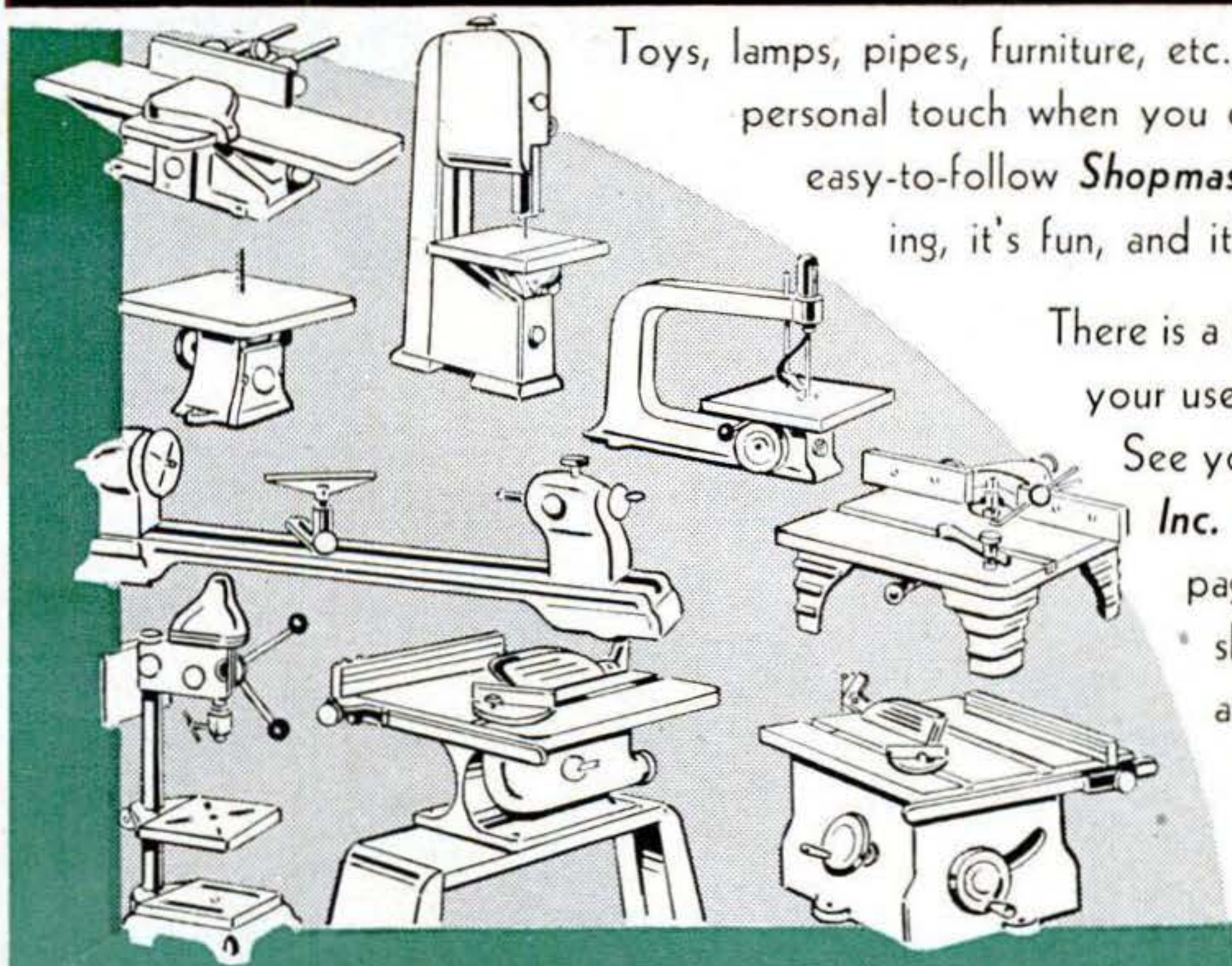

Toys, lamps, pipes, furniture, etc., will have that personal touch when you create them with easy-to-follow ***Shopmaster*** Plans. It's relaxing, it's fun, and it's profitable.

There is a famous ***Shopmaster*** Tool for your use, priced for your pocketbook. See your dealer, or write ***Shopmaster, Inc.*** for your copy of the new 28-page full-color illustrated catalog showing a complete line of tools and accessories.

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54 Coaster Set and Rack
55 Toy Duck
56 Broom Holder
57 Novelty Tie Rack
58 Bouncing Dog Toy
59 Pull Toy Train
60 Gun Rack
62 Bird House
63 Rolling Hobby Horse
64 Kiddie Car
67 Picket Fences
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TWO FIFTY

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ONLY $199.50 FOR A COMPLETE POWER WORKSHOP

Your complete power workshop in just 18" x 60" floor space. With ½-hp. ball-bearing motor illustrated, **$199.50.**

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REG. TRADE MARK

FOR less than $200—and with eight square feet of floor space—you can have a power shop second to none in capacity, accuracy and flexibility. It's SHOPSMITH—five heavy-duty, extra-feature tools in one unit so beautifully engineered, so ingeniously designed that you can convert from tool to tool *in less than 60 seconds.*

NEVER BEFORE SUCH AMAZING CAPACITY

Imagine a circular saw that cuts to center of 8′ plywood panels . . . a lathe that takes work up to 15 inches in diameter . . . a drill press that mortises doors and panels as easily as it drills miniature parts . . . a disc sander that squares, miters and finishes with "try square" accuracy. You get these, and more, with SHOPSMITH.

OUTPERFORMS SINGLE-PURPOSE TOOLS

Compare SHOPSMITH with any combination of single tools at any price. Compare it for accuracy, capacity, all-round utility. You'll see why the thousands of men who own SHOPSMITH praise it so enthusiastically. On display at any Montgomery Ward store and at leading hardware or department stores. SHOPSMITH, complete with attachments, costs $169.50. With heavy-duty ½-hp. ball-bearing motor, $199.50.

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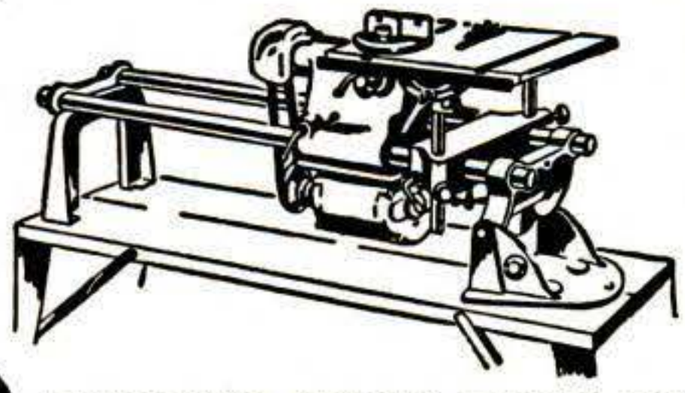
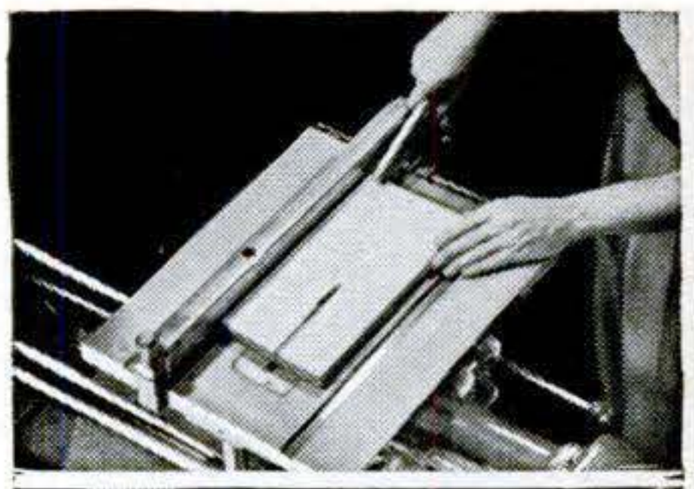
5 RUGGED POWER TOOLS IN 1

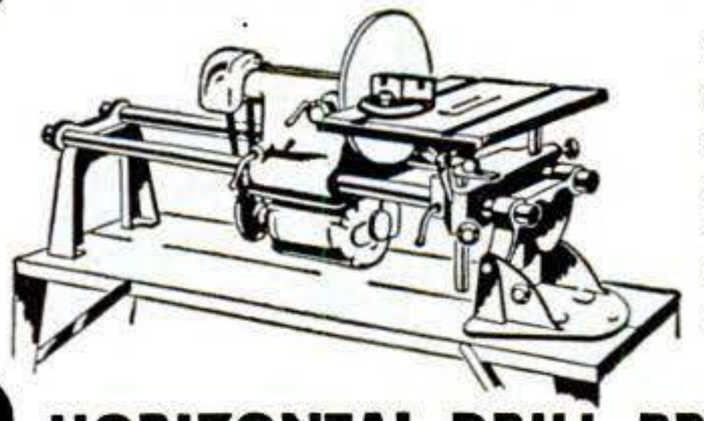
1 EIGHT-INCH CIRCULAR SAW



Effective table width up to 56". Maximum depth of cut, 2¼". Machined cast-aluminum tilting table, ribbed for extra strength. Precision-tooled rip fence and miter gauge. Unique micro-adjustment permits extremely accurate ripping.

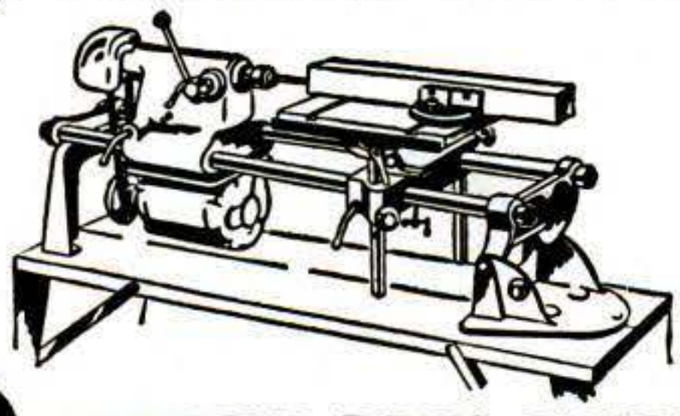


2 TWELVE-INCH DISC SANDER

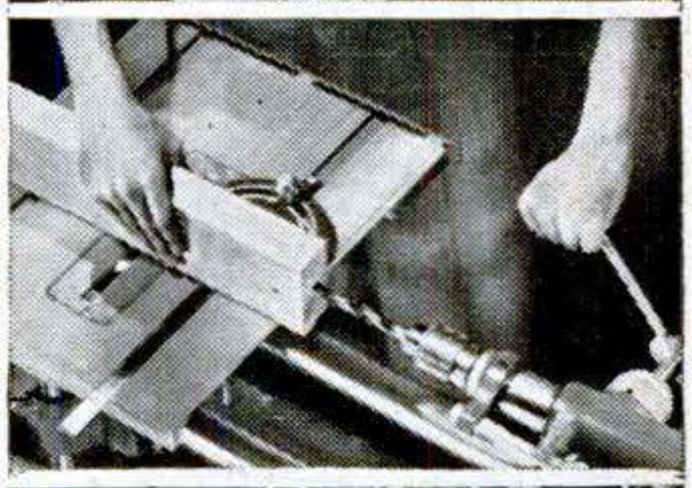


Cast-aluminum disc easy to attach and remove. Extra-large, adjustable table measures 14½" x 17". Miter gauge and rip fence can be used for accurate squaring and jointing. Has features found in no other disc sander.

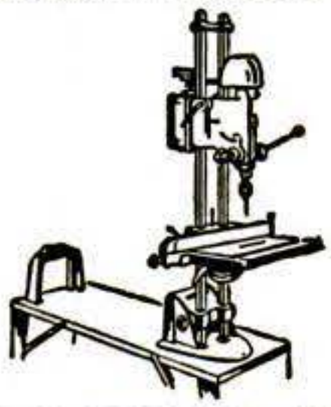
3 HORIZONTAL DRILL PRESS



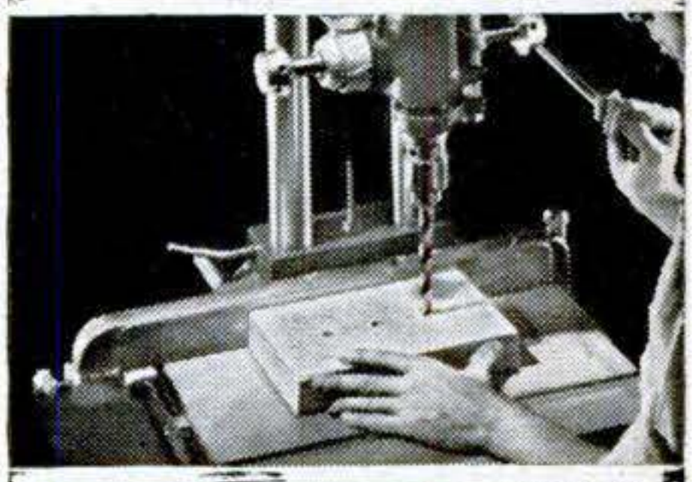
Extremely useful operation possible only with SHOPSMITH. 4" quill feed, automatic stops. Permits large, heavy pieces to be drilled or mortised quickly and accurately. Eliminates need for jigs. Length of work limited only by size of room.



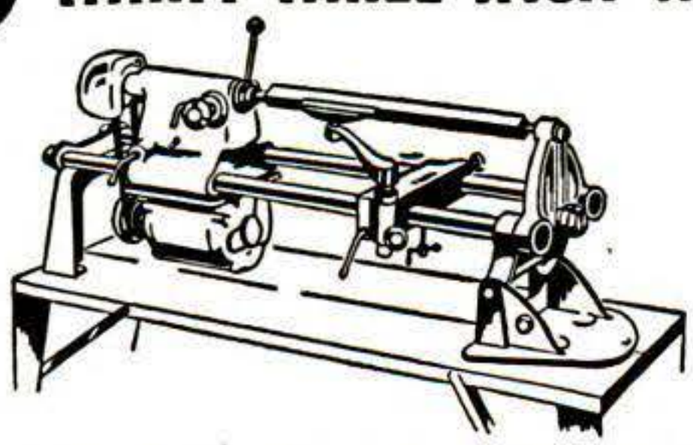
4 VERTICAL DRILL PRESS



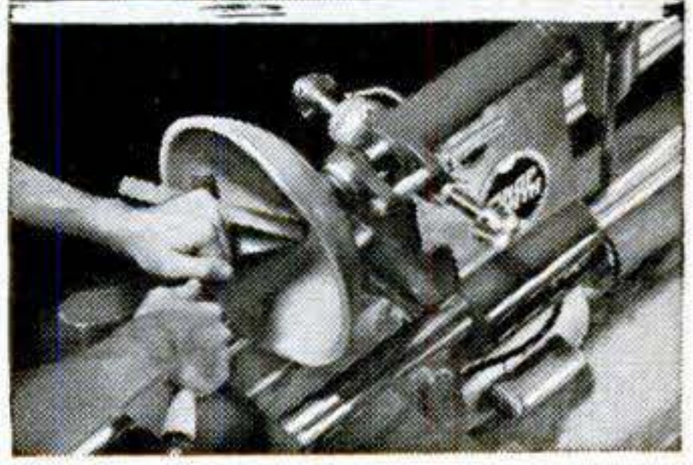
SHOPSMITH drills to the center of a 15" circle, has a maximum clearance table to chuck of 27". Jacobs key chuck takes drills from 5/64" to ½" diameter. Rugged, six-spline spindle with 4" feed. Variable speeds 875 to 3500 rpm.



5 THIRTY-THREE-INCH WOOD LATHE



With a 15" swing, SHOPSMITH has greater capacity than most other heavy-duty lathes. Distance between centers, 33". Swivel-arm tool rest always slides parallel to ways—no need for constant adjusting. Has 4" quill feed. Quickly adaptable for oversized faceplate work.



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Address **SHOPSMITH, Dept. 102-A,**
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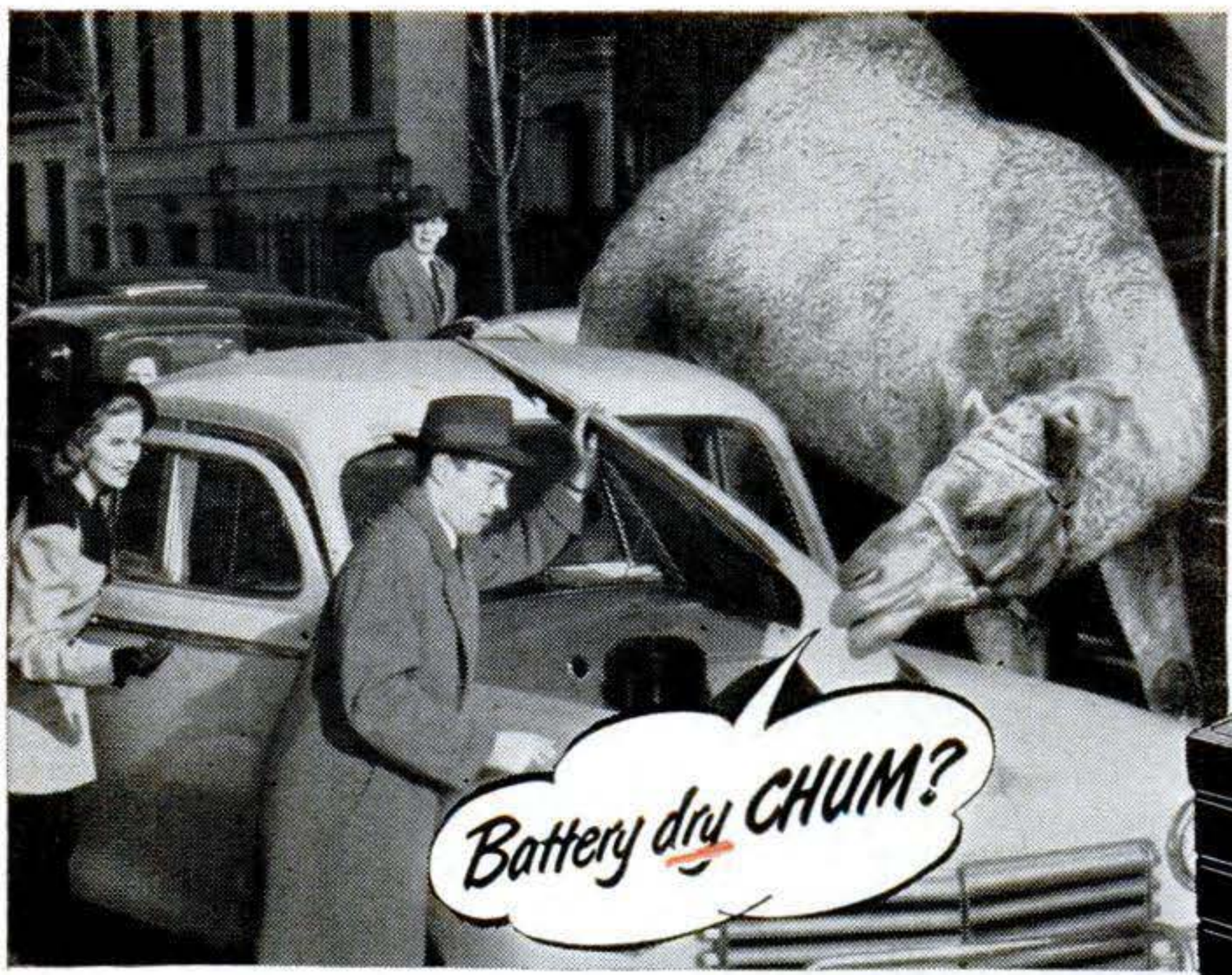

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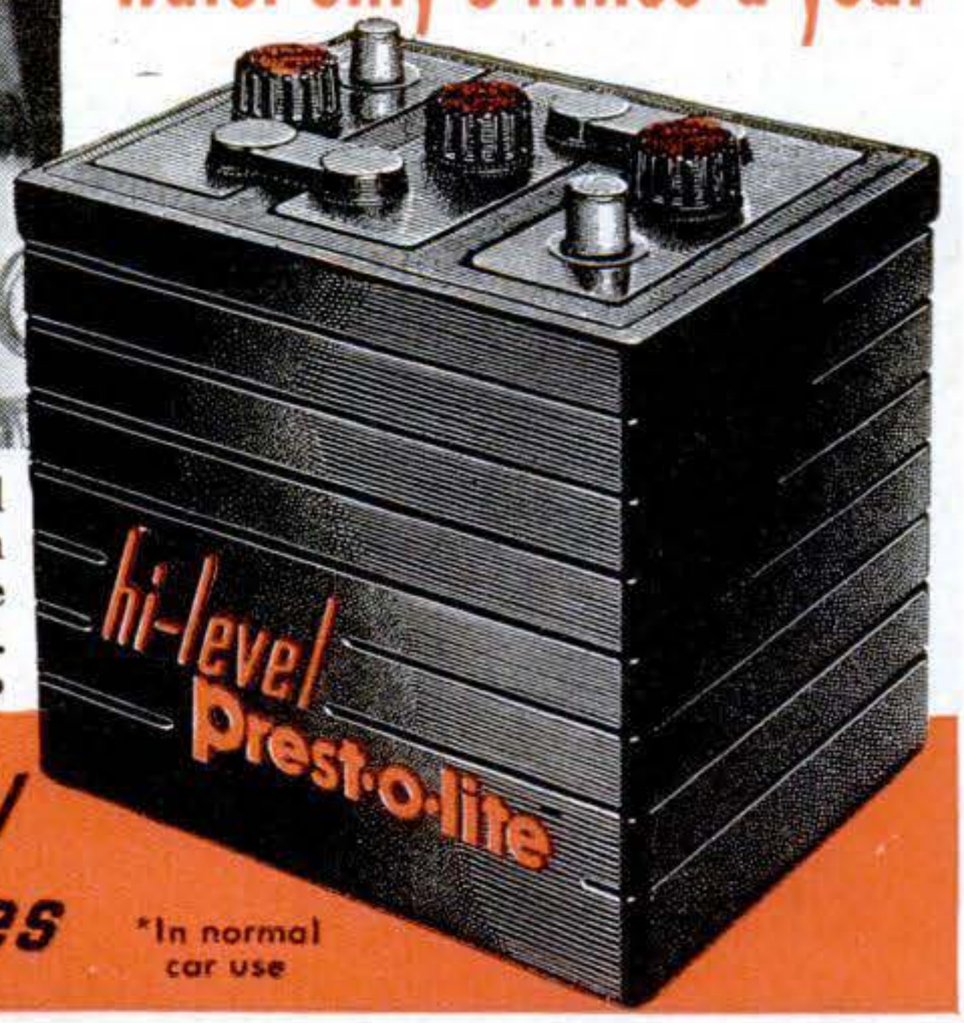
hi-level batteries... need water only 3 times a year*



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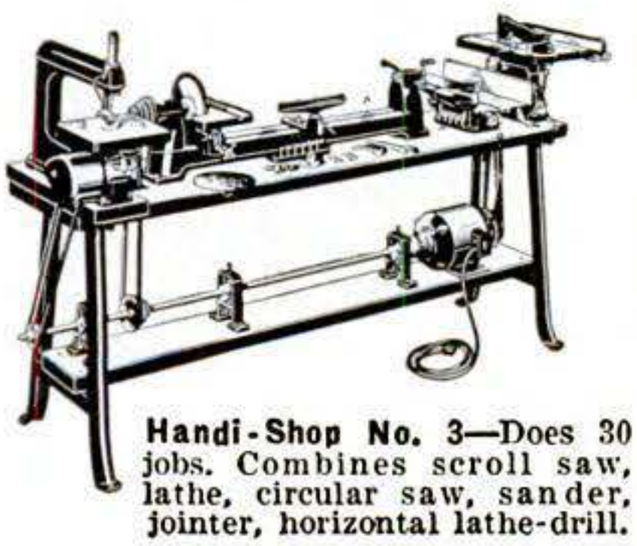

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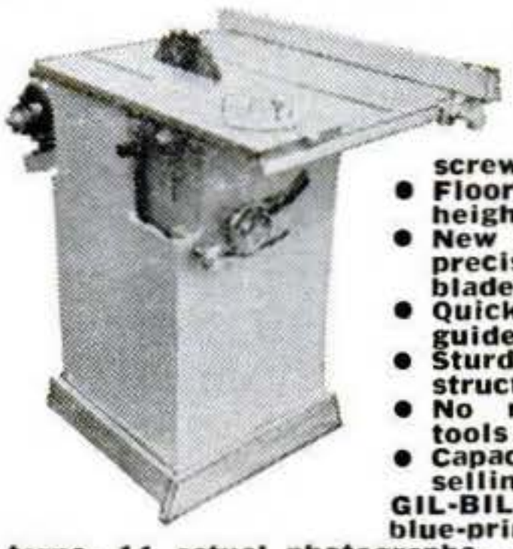

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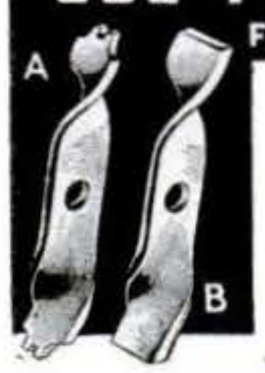

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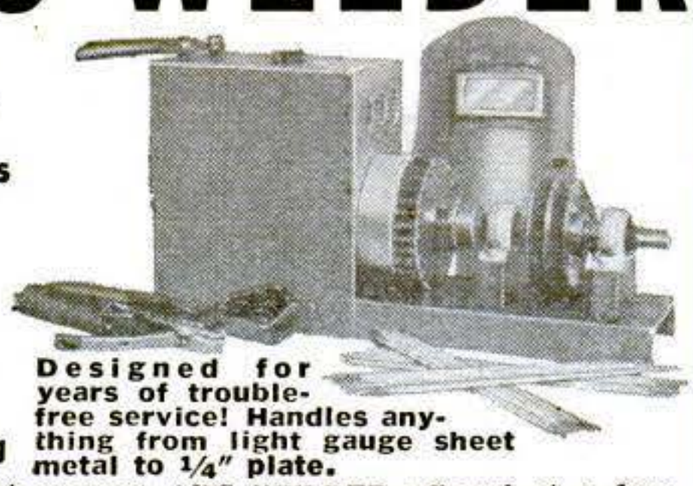

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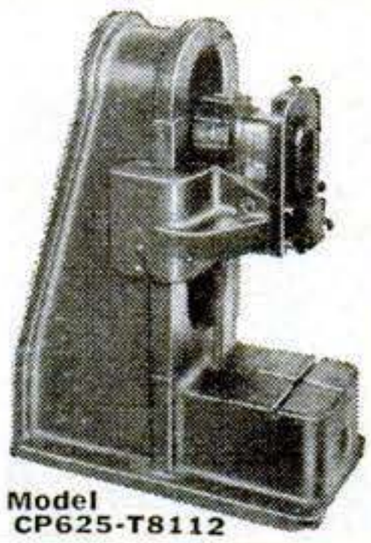

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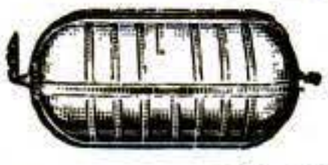

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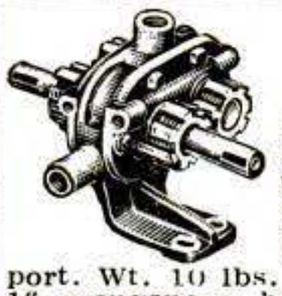

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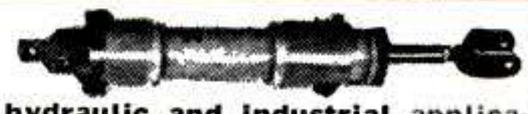
Hydraulic Cylinders-Air or Oil



Use hydraulics on arbor presses, hydraulic presses, hay lifts, manure loaders, lift trucks—push or pull, tilt or turn, press or squeeze, open or close, lift or lower—and other hydraulic and industrial applications. Use with either air or oil . . . of finest precision workmanship.

Item #4—Double action, 1" bore, 3" stroke, will lift 770 lbs. in 1/10 of a second using Logan Pump. All steel barrel. Ideal for controls, door openers, positioning, etc. An $18.00 value . . . . . **postpaid** **$4.95**

Item #33—Double action, 1½" bore, 5" stroke, will lift 1760 lbs. in one second with Logan Pump. Wt. 3 lbs. A $35.00 value . . . . . **postpaid** **$8.95**

Item #32—Double action, 1½" bore, 9" stroke, will lift 1760 lbs. in one second with Logan Pump. Wt. 4 lbs. A $45.00 value . . . . . **postpaid** **$10.95**

Item #16—Use these cylinders on farm trucks, bulldozers, hay lifts, manure loaders, etc. Double action, 1½" bore, 27" stroke. (Will lift 1760 lbs. in 2 seconds with Logan Pump). Wt. 8 lbs. A $55.00 hydraulic cylinder value for only . . . . . **postpaid** **$12.95**

Item #17—Double action, 2⅜" bore, 8" stroke. (Will lift 4400 lbs. in one second with Logan Pump). Will withstand 1500 P.S.I. against wall. Wt. 7 lbs. A $65.00 value . . . . . **postpaid** **$14.50**

Item # 20. Double action, 2⅜" bore, 4" stroke, two-way solid ⅝" alloy steel shaft (will lift 4400 lbs. in one second with Logan Pump). A $73.00 value . . . . . **postpaid** **$16.50**

Item # 15. Double action, 3" bore, 8½" stroke. All steel hydraulic cylinder, will lift up to 12,000 lbs. (7000 lbs. in 3 seconds with Logan Pump). Complete with fittings. Wt. 12 lbs. A $78.00 value . . . . . **postpaid** **$19.50**

Item # 31. Double action, 3½" bore, 11" stroke. (Will lift 9600 lbs. in 7 seconds using Logan Pump.) Complete with fittings. Wt. 15 lbs. A $92.00 value . . . . . **postpaid** **$22.50**

Item # 6. Double action, 3" bore, 23" stroke, hydraulic cylinder will lift 7070 lbs. in 5½ seconds using Logan Hydraulic Pump. Especially suited for farm and construction machinery. Clevis mounting for easy use. Wt. 22 lbs. A $145.00 value. **F.O.B. Chicago** **$27.50**

HI-PRESSURE FITTINGS for cylinders and valves available at 35c ea. for ⅜" pipe and 50c ea. for ½" pipe.

HYDRAULIC CONTROL VALVES

(Item #37)

LOGAN HEAVY DUTY OIL
Hydraulic Control Valve

BRAND NEW control valve with built-in adjustable relief valve, will operate one double-acting hydraulic cylinder or two cylinders as one or a reversible hydraulic motor. Valve handle latches in neutral position. Made of rugged cast aluminum alloy. Open center unloads the pump in neutral position. Throttling control allows operator to regulate the speed of movement of the hydraulic cylinder or motor. Has removable mounting brackets with 4 bolt holes, ⅜" pipe thread connections. Overall dimen.: 12½" Hx8½"Dx8"W. Ship. wt. 17 lbs. Govt. Acquisition. Cost over $100.00. An Excellent Buy. **F.O.B. Chicago** **$21.95**

BRAND NEW

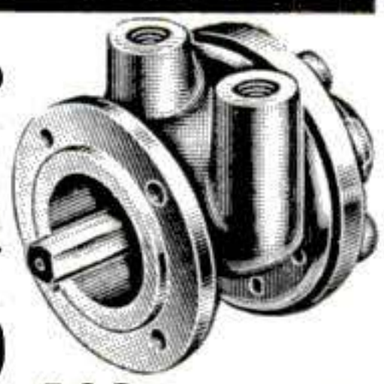
Item # 24. Four-way control valve for use with double action hydraulic cylinder, may be used with 1500 P.S.I. hydraulic system to open and close hydraulic cylinders. Brand new. Ship. wt. 4 lbs. A $38.00 value . . . . **postpaid** **$7.95**

Item #26. Four-way control valve for use with two hydraulic double action cylinders. Each cylinder may be operated independently of the other or in conjunction with the other. Oil may be locked in any of the cylinders to hold the piston at any required position. Brand New. Ship. wt. 6 lbs. A $60 value **postpaid** **$10.95**

Item #28. A two cylinder double action valve with a unique arrangement, allowing the operator to raise both cylinders simultaneously, to lower them simultaneously or to raise one and lower the other at any predetermined rate and speed. Brand New. Ship. wt. 8 lbs. A $75.00 value . . . . . **postpaid** **$14.95**

HYDRAULIC PUMPS

LOGAN HEAVY DUTY OIL
HYDRAULIC PUMP



BRAND NEW . . . for operating hydraulic cylinders and hydraulic motors on tractors, bulldozers, construction machinery, lift trucks, industrial applications, etc. Delivers 8 GPM at 1200 RPM at 1000 P.S.I. using 5 H.P. Has ½" pipe thread inlet, ⅜" pipe thread outlet, ¾" shaft with flat and keyway for direct or pulley drive. Has flange with 4 bolt holes for convenient mounting. Ship. wt. 22 lbs. Overall dimen.: 7" L x 5½" H x 5½" W. A $105.00 value. FOR ONLY **$22.50**

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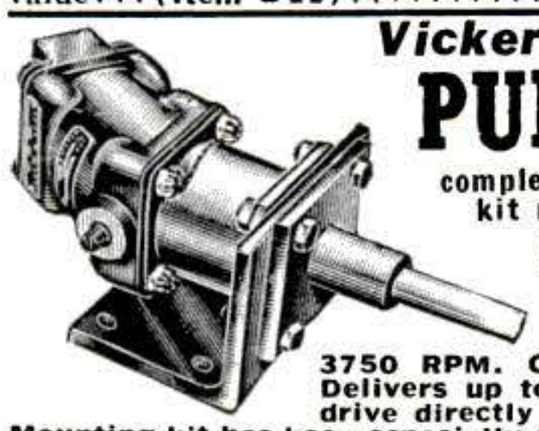

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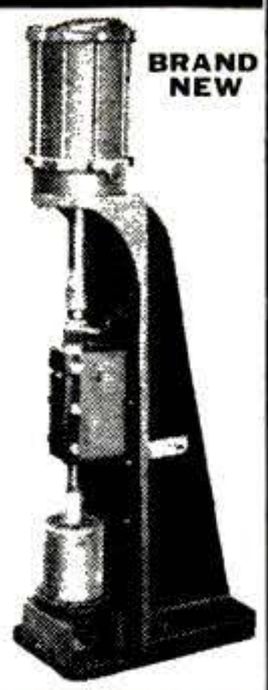

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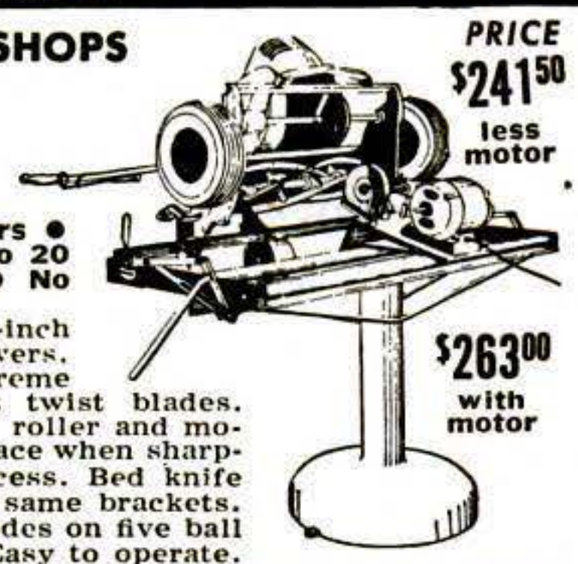

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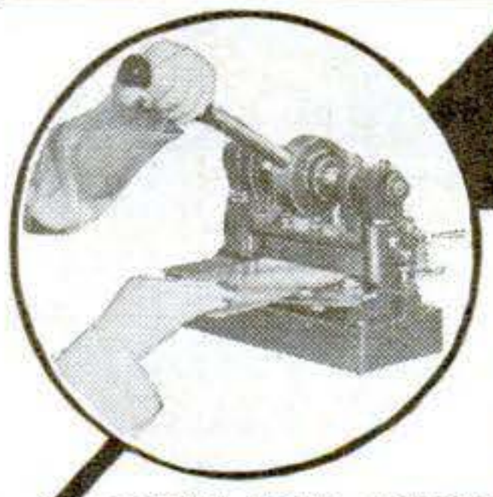

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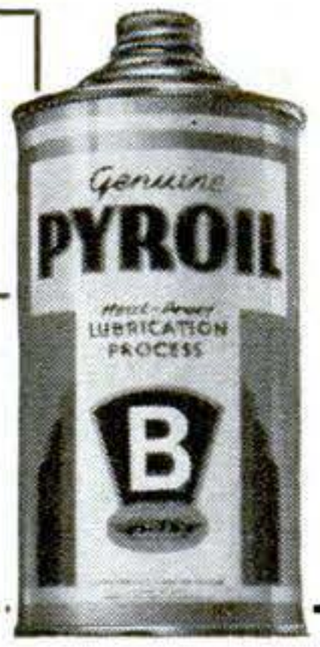

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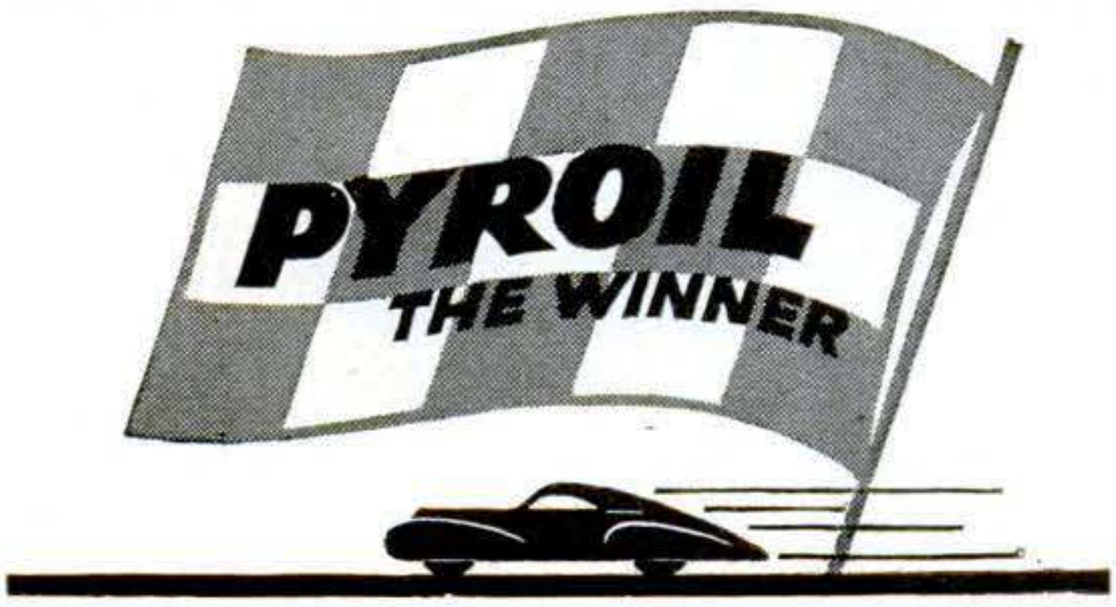

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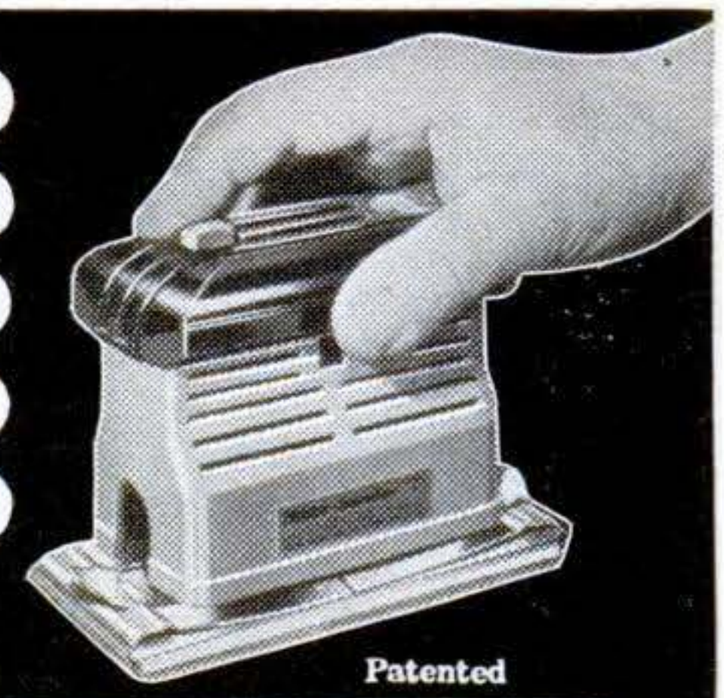

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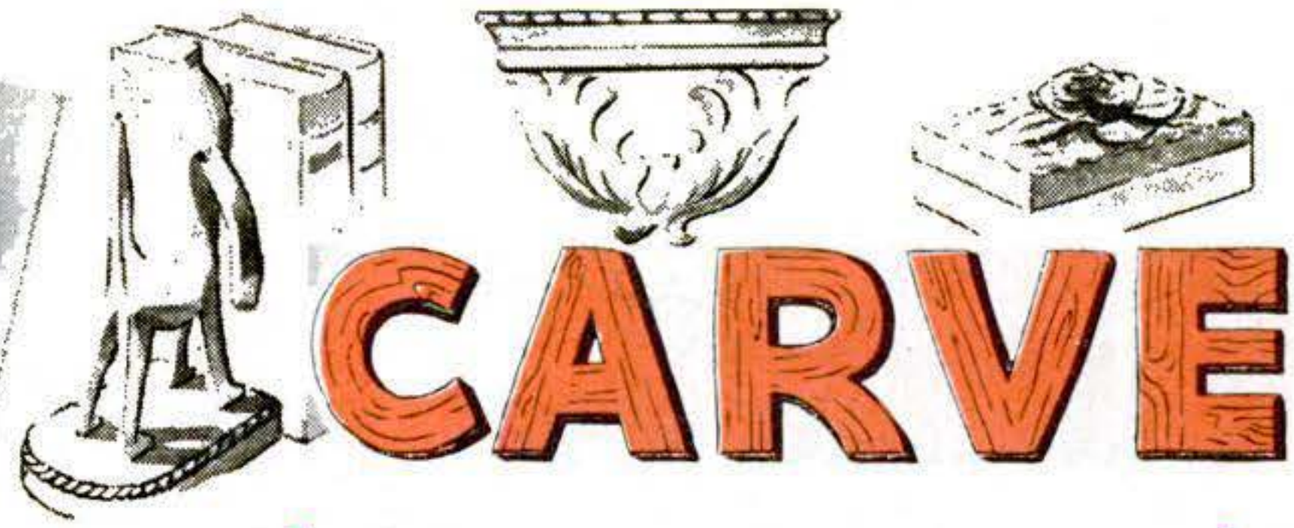

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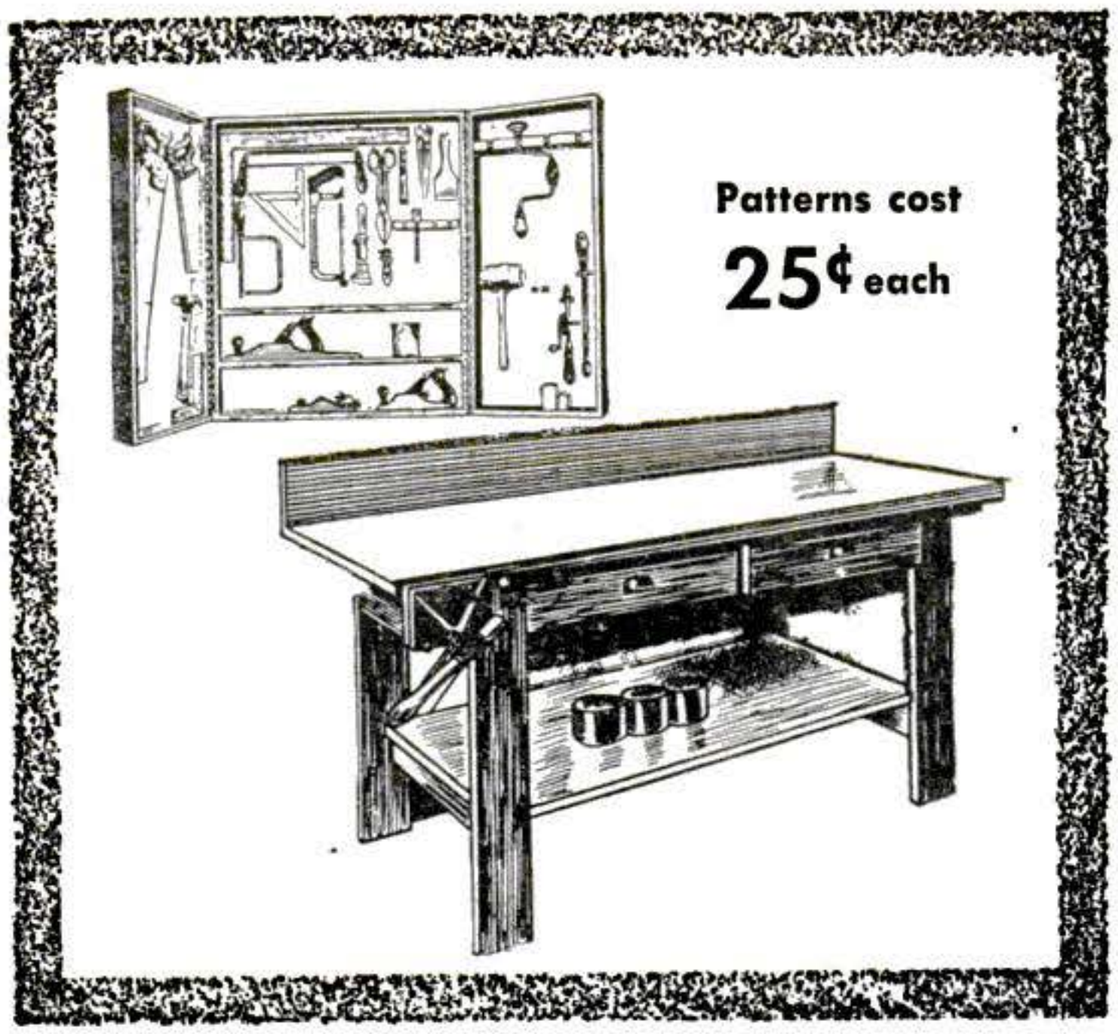

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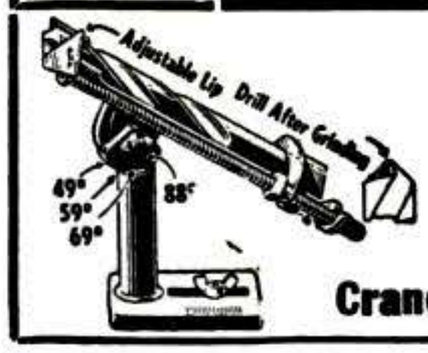

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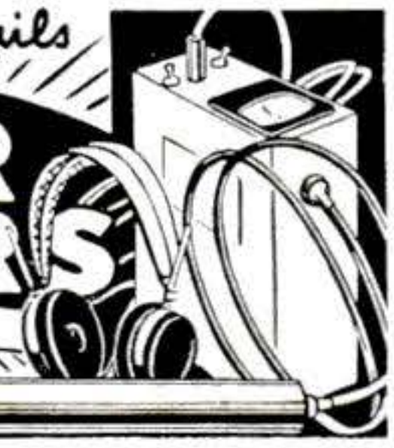

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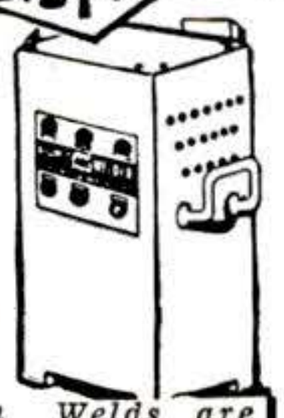

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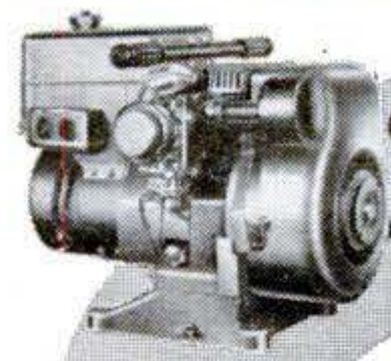

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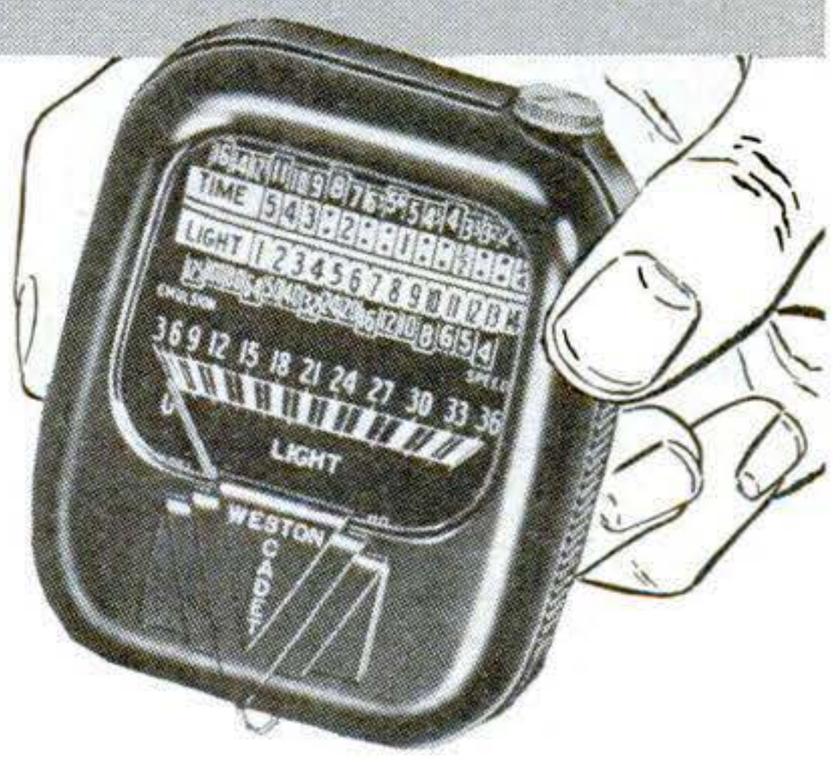

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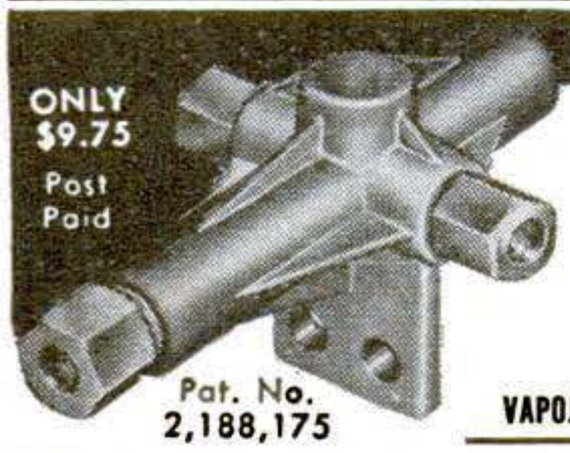

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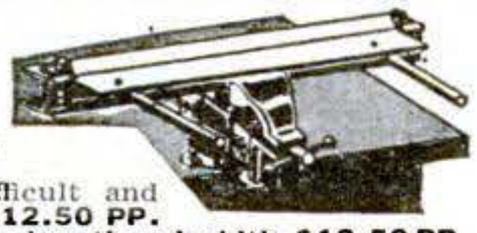

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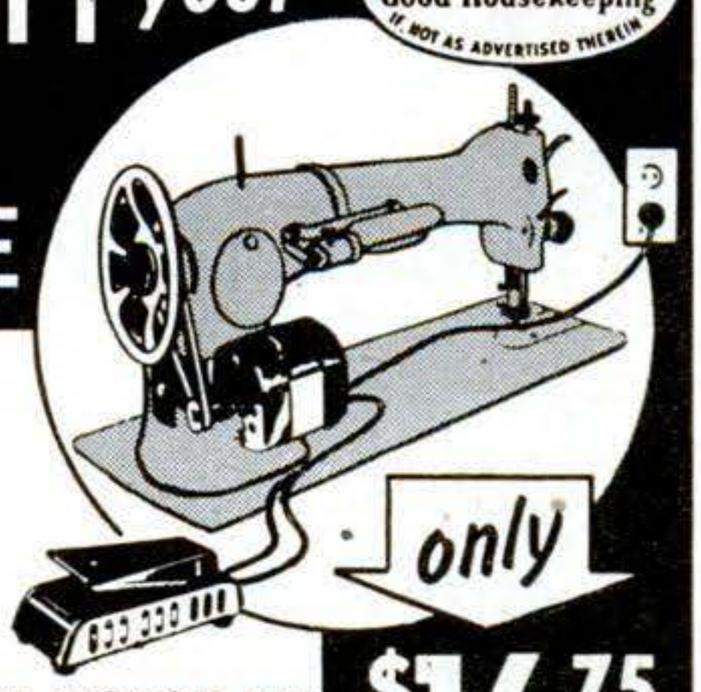

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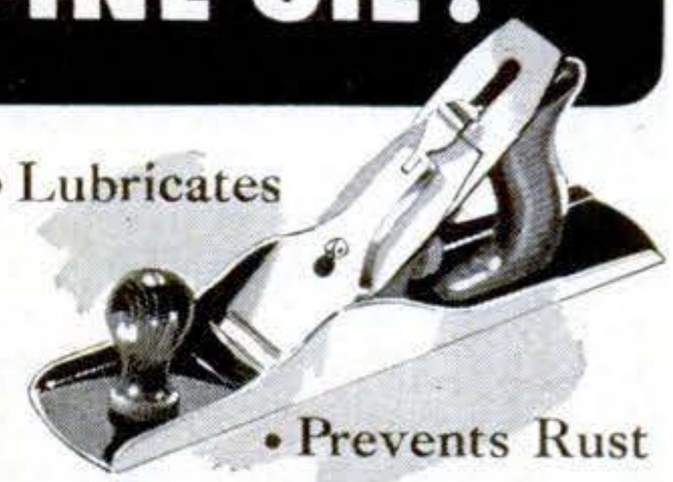

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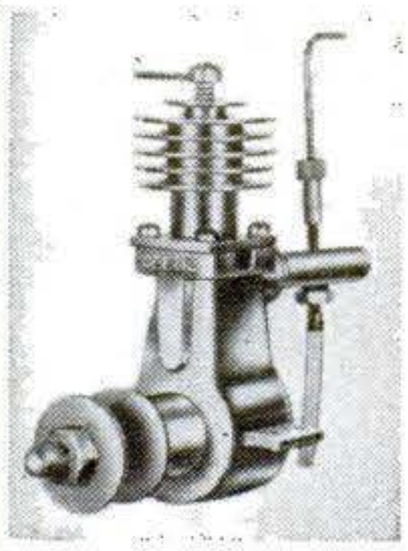

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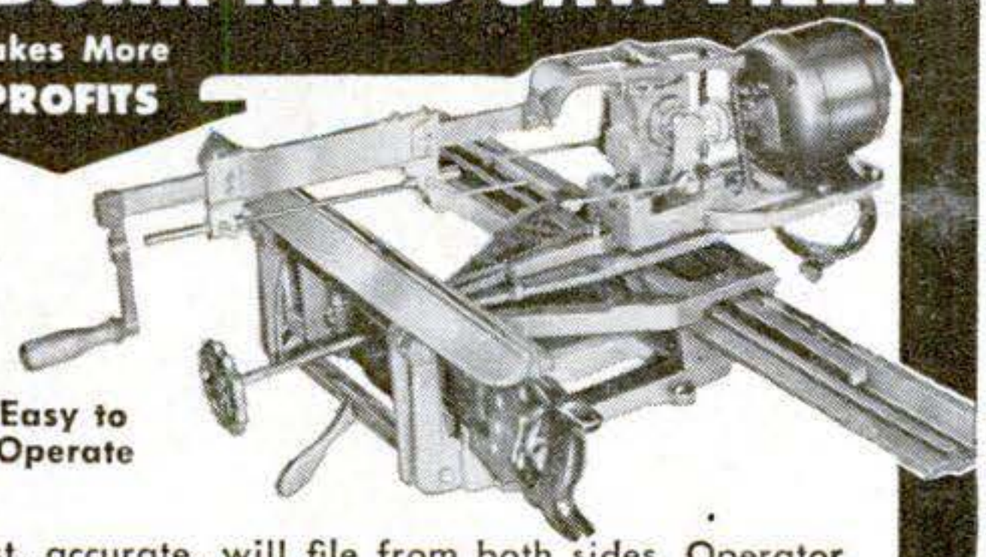

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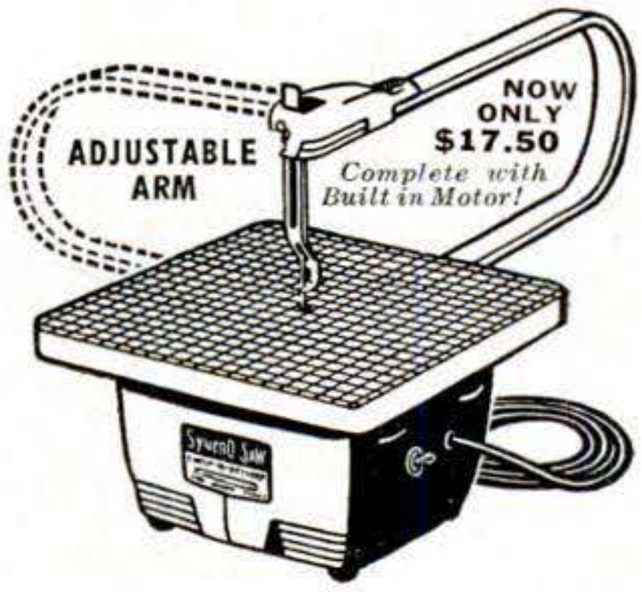

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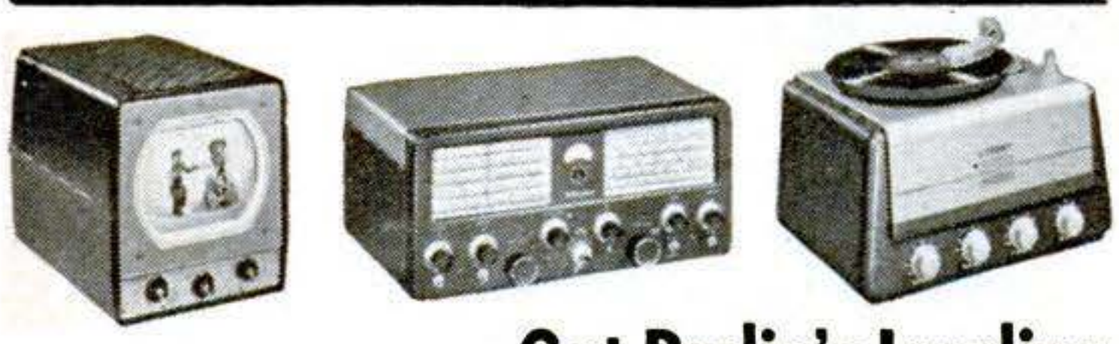

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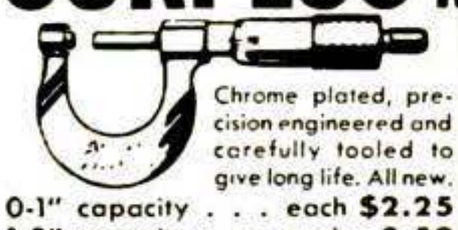

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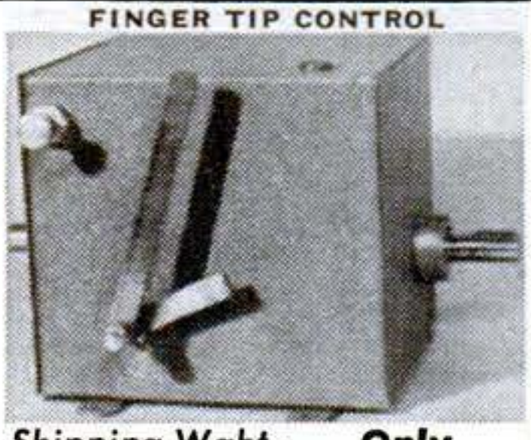

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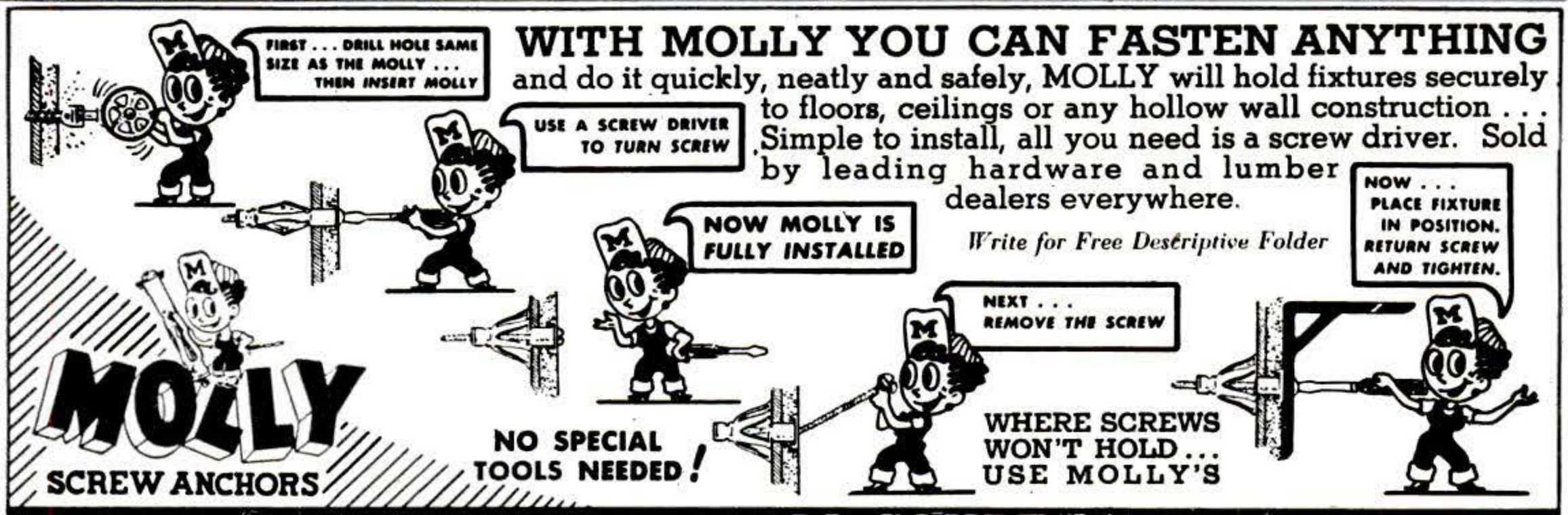

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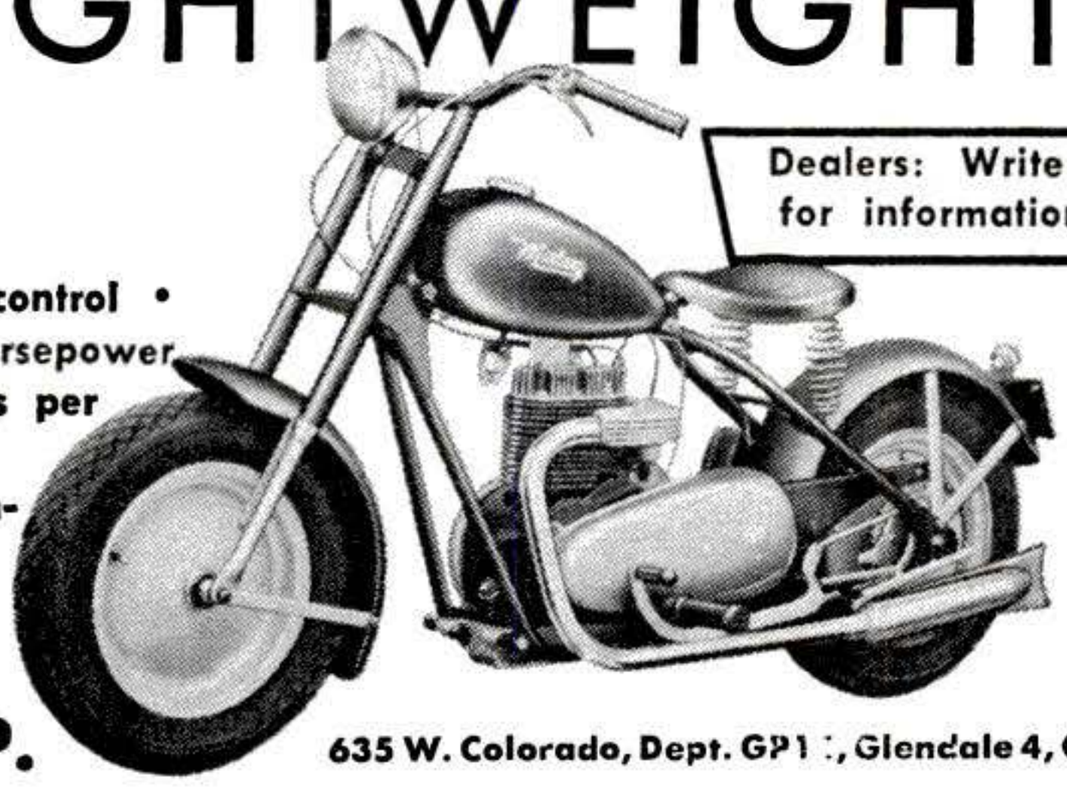

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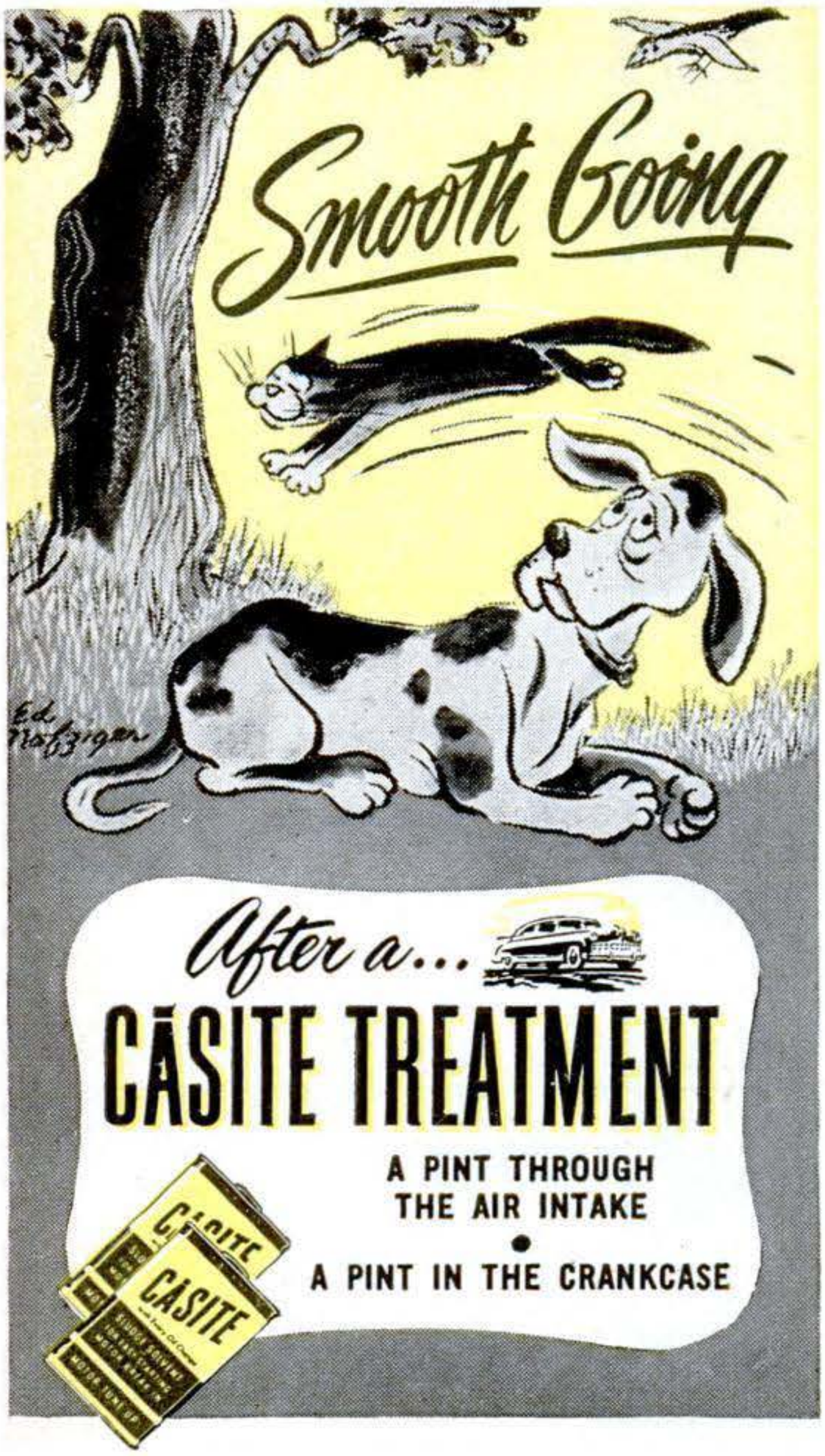

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FOR AUTO—HOME APPLIANCE & FARM IMPLEMENT REPAIRS! WORKS ON IRON, STEEL & other metals . . . does work you'd expect from a larger, costlier machine; portable, easily carried; **OPERATES FROM ANY** properly wired **110 VOLT LINE.** Also available for 220 volt operation at slight additional cost; has 8 metalic & carbon arc welding heat stages. **EASY TO OPERATE TRANSFORMER TYPE WELDER**—If inexperienced you can learn to do professional work by following the **SIMPLIFIED WELDING & OPERATING INSTRUCTIONS FURNISHED**—comes complete ready to operate with helmet, rods, cable, instructions. **SAVE TIME AND MONEY**—Do your own welding—Just a few repair jobs will pay for this machine. A practical and profitable machine tool for any workshop. Make money doing repair work for others. Costs a few cents to operate.

SPECIAL GIFT OFFER! WORTH $6.80 ARC TORCH YOURS at NO EXTRA COST!

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The famous Casco power-head in every Casco Kit is an amazing Jack-of-all-trades that does 1,001 jobs at vibrationless *super*-speed. Precision-built! Powerful fractional HP, AC-DC motor. Oilless bearings. On-off switch. Unbreakable plastic Tenite case. Special safety sleeve. Non-slip chuck. (Free 36-page Project Book with every Kit!)

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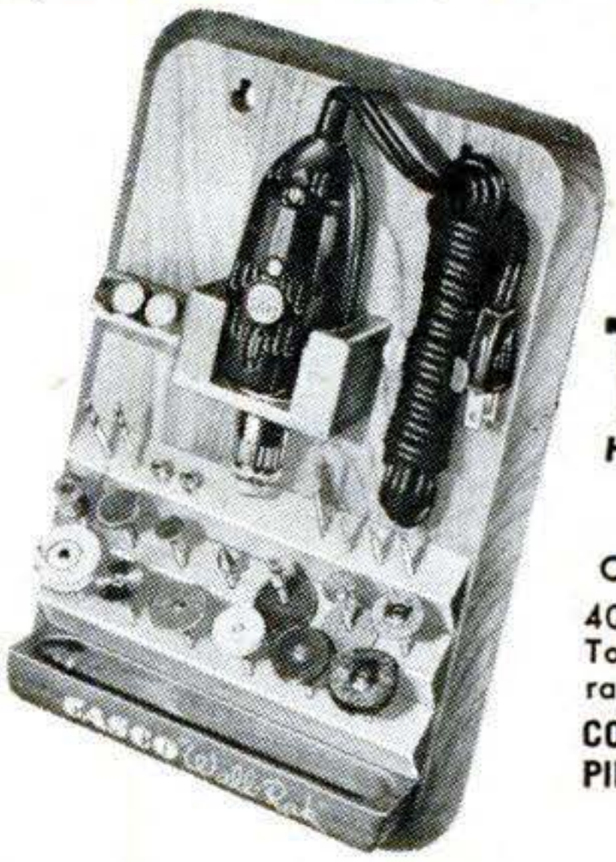
For Wood, Metal, Plastics, Fibre, Glass, Leather.



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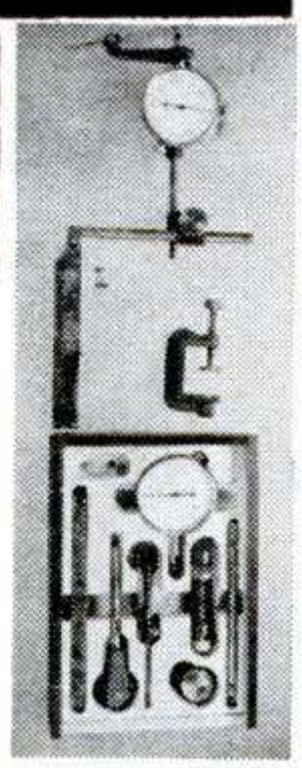
AMES UNIVERSAL DIAL INDICATOR SETS



New Surplus

Dial indicator-face-2¼" graduated in 1/1000ths. Dial reading-o-50-0; spindle travel—¼: can be used on stationary or revolving parts on lathes, milling machines, drill presses, etc. and for automotive work. Comes complete with dial gage, hole attachment, bar with upright, clamp sliding swivel, dial holding rod and 3 contact points—with case shown.

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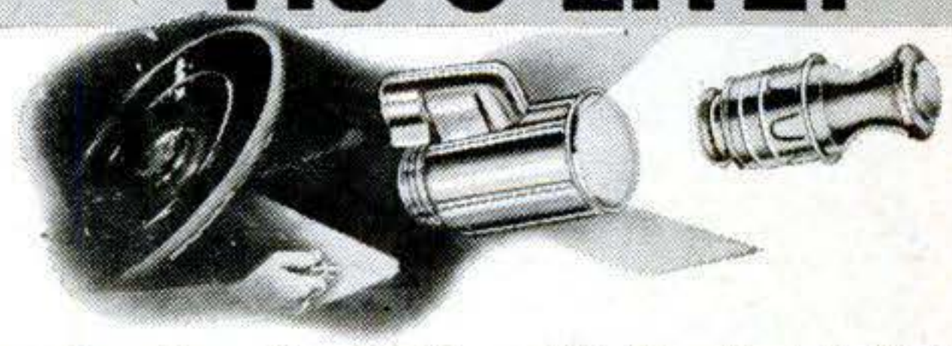

Amazing New Car Lighter with Illuminated Well!

Pops out *automatically*. While you light up, the lighter well glows softly . . . guides your hand surely back. No more fumbling or taking your eyes off the road! No more marring or scratching of dashboards! Casco-made, as are 9 out of 10 car lighters. Easy to install . . . now at Car Dealers, Auto Supply Stores, Garages, Service Stations . . . **$2.75**

Vis-O-Lite illuminated well assembly alone (uses your original pop-out unit) **$1.25**
Replacement pop-out unit only **$1.50**

CASCO CASCO Products Corp. Bridgeport 2, Conn.

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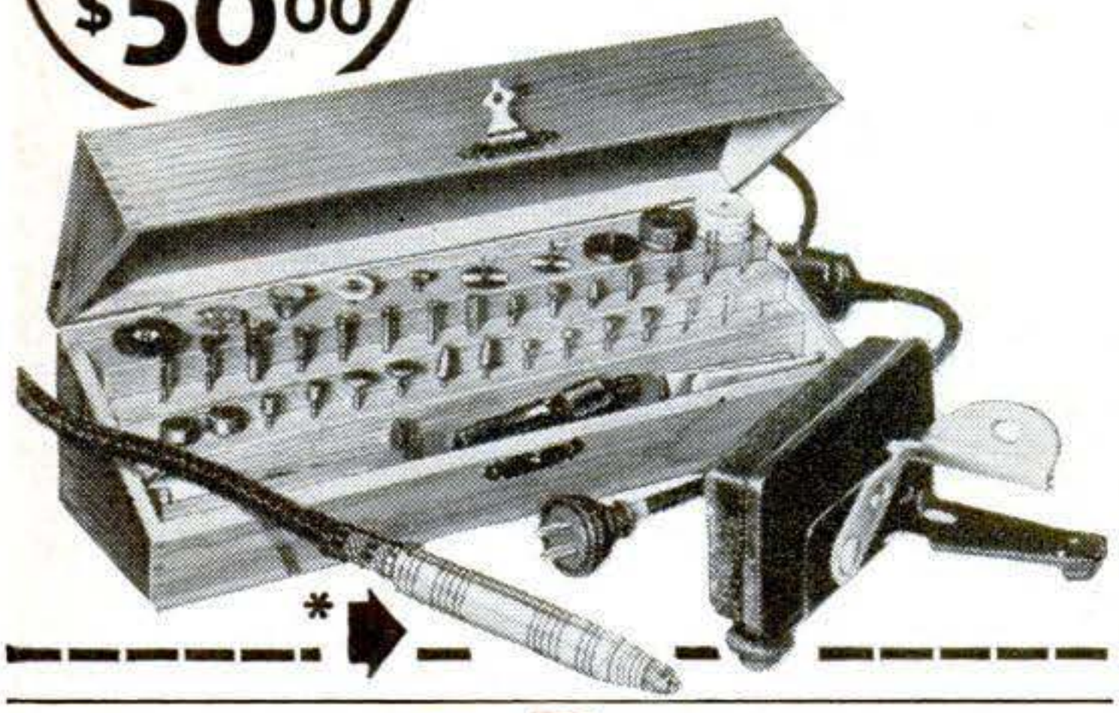
FLEX-O-SHAFT and complete Tool Kit with 66 accessories ONLY $50.00



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Mufflers—All Ford, Chev., Ply.....$4.45
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Dodge, Hudson, K.F., Pack., etc.....$5.45
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Complete outfit consisting of compressor, pressure tank, air gauge, air chuck, 20-ft. hose, pop valve, copper tubing with 4 brass flared fittings for connecting compressor to tank, 4-way cross and 3 nipples. Complete outfit of 7 items.....ONLY **$29.95** SHIPPING WT. 40 LBS.

COMPRESSOR SEPARATELY.....$21.50

Equipment less compressor..... $10.50

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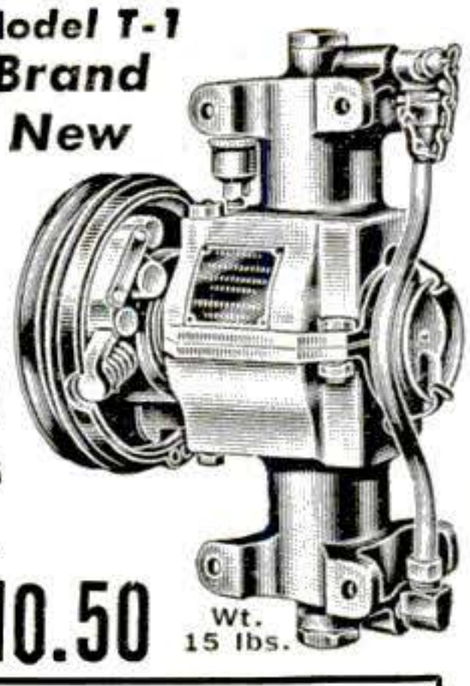
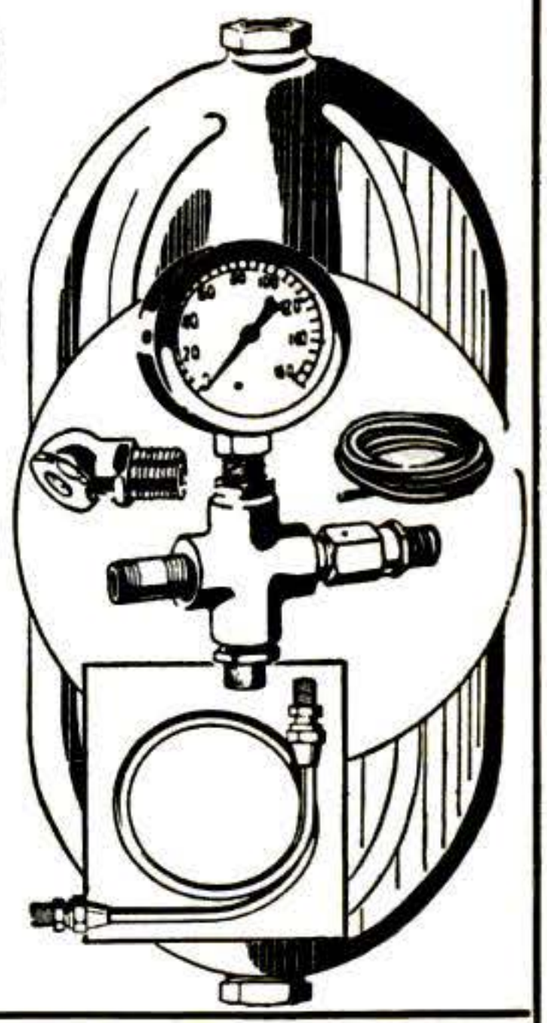


Wt. 15 lbs.



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Wherever Compressed Air is Needed

For spraying paints, insecticides, etc.; inflating tires, operating air tools and many more uses. Automatic clutch makes it suitable for mounting and operating from trucks, tractors, etc. Instructions furnished. A fortunate purchase from the government enables us to offer you this amazing buy. All brand new equipment. Replacement parts available.

This low price is but a fraction of the price of manufacturer and of leading mail order houses.

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Piston Type, 2-cylinder, 2 inch bore, 1½" Stroke Ball Bearing. 3.27 C.F.M. at 600 R.P.M. Capacity up to 6.54 C.F.M. Suggested operating pressure 75 P.S.I. DIMENSIONS: 9" wide, 11⅞" high, 6⅝" deep. Wt. 26 lbs.

TANK and ACCESSORIES

6" x 24" stainless steel tank suitable for 150 lb. pressure. Two ¼" openings. Air gauge, pop valve, air chuck, 20 ft. hose, Copper tubing and fittings as shown. Wt. 15 lbs.

PORTABLE SPRAY OUTFIT

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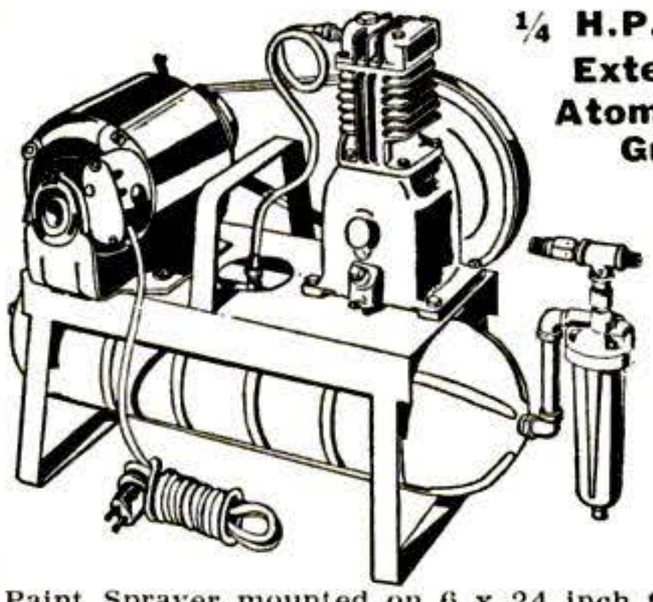


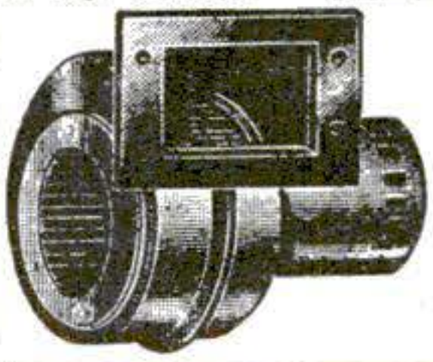
¼ H.P. Heavy Duty External Atomizing Gun

None Better at Double This Price

Paint Sprayer mounted on 6 x 24 inch tank, ¼ H.P. 110 V. 60 cy. Heavy duty motor with overload relay, 10 ft. cord and plug, V Belt drive. Piston-type Compressor with 2 Compression rings, 1 oil ring, 2 inch Bore, 1¾ inch stroke, displacement 2.86 C.F.M. at 60 lbs. pressure, Safety Valve. Gun **external atomizing.** Flat and round spray, quart cup; maintains 35 to 40 lbs. working pressure. Oil and water extractor, 1 air gauge, 20 ft. heavy duty 2-braid air hose with leak proof fittings, complete with carrying handle. Net weight 54 lbs., ship. wt. 60 lbs..... **$57.50**

Outfit less motor $47.50
Compressor only 17.50
Spray gun and 20 ft. hose 12.95

140 CFM "WELLWORTH" BLOWER



Single-inlet blower that gives top performance on heating, ventilating, exhausting, cooling, drying and similar applications. 5⅛ x 4' mounting flange with 2½" square discharge. 3½" dia. blower wheel powered by direct-connected 1/15 H.P., 110V., 60C., A.C. motor with conduit box and 20" leads. 7½" wide less flange by 7¼" H. x 6¾" D. Suited for hundreds of new and replacement uses. Shpg. wt. 6 lbs... **$16.50**

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USED, GUARANTEED LIKE NEW.

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CP4X Pistol grip handle. Takes up to 3/16" rivet. Weight 6 lbs. List price $73.00.

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Same as above, brand new..... $22.50

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With ¼" Jacob Chuck. Wt. 2 lbs. List price $55.00. Only..... **$17.50**

Ingersoll Rand AIR DRILL

With ¼" Jacob Chuck. Wt. 2 lbs. List price $55.00. Only..... **$17.50**

AUTOMATIC COMPRESSOR UNIT

1/3 H.P. heavy duty capacitor motor AC 110/220 volt 60 cycle, 2 x 1¾ inch piston type compressor, splash feed lubrication. 12 x 24 inch tank, automatic pressure switch, pressure range 100 to 125 lbs., CFM 2.2, check valve, safety valve, air regulator with gauge and filter, 20-ft. air hose with air chuck for inflating tires. V. belt drive. Shipping wt. 90 lbs.

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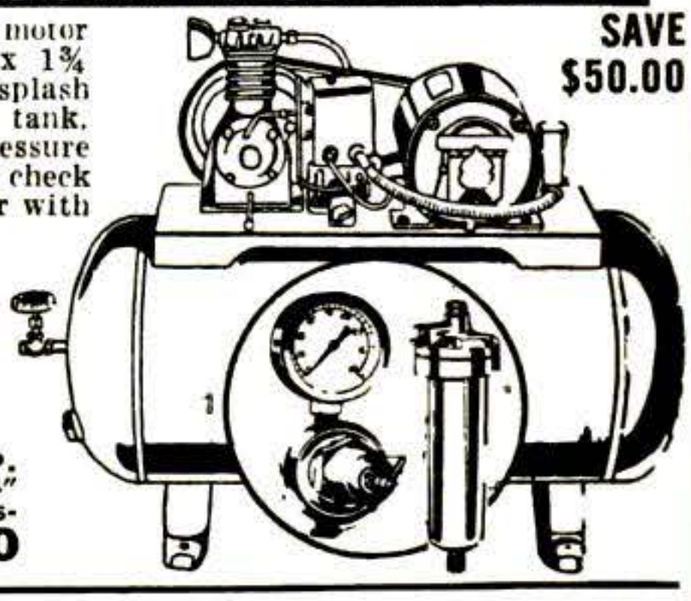

Special Price $79.50

Same unit as above with ½ H.P. motor, furnished with 13" x 24" tank. CFM 2.8 at 125 lb. pressure. Shipping wt. 125 lbs.... $98.50

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AUTOMATIC PRESSURE SWITCH with UNLOADER

Double pole, with 2 way release valve. Set at 125 to 150 lbs. pressure. Wt. 4 lbs. Only.. **$10.25**

Same without unloader **7.50**

Switch—20 to 40 lb. adjustable to 80 lbs. For air or water.....**5.50**

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¼" valve.....**$2.75**
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REDUCING VALVE AND GAUGE

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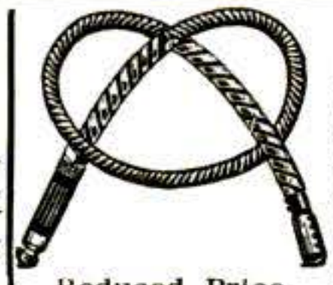

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12 volt D.C. motor. 2450 R.P.M. 2.0 amps. ¼" shaft. Size overall 3" x 4". Weight 3 lbs. USE AS 6 VOLT GENERATOR.

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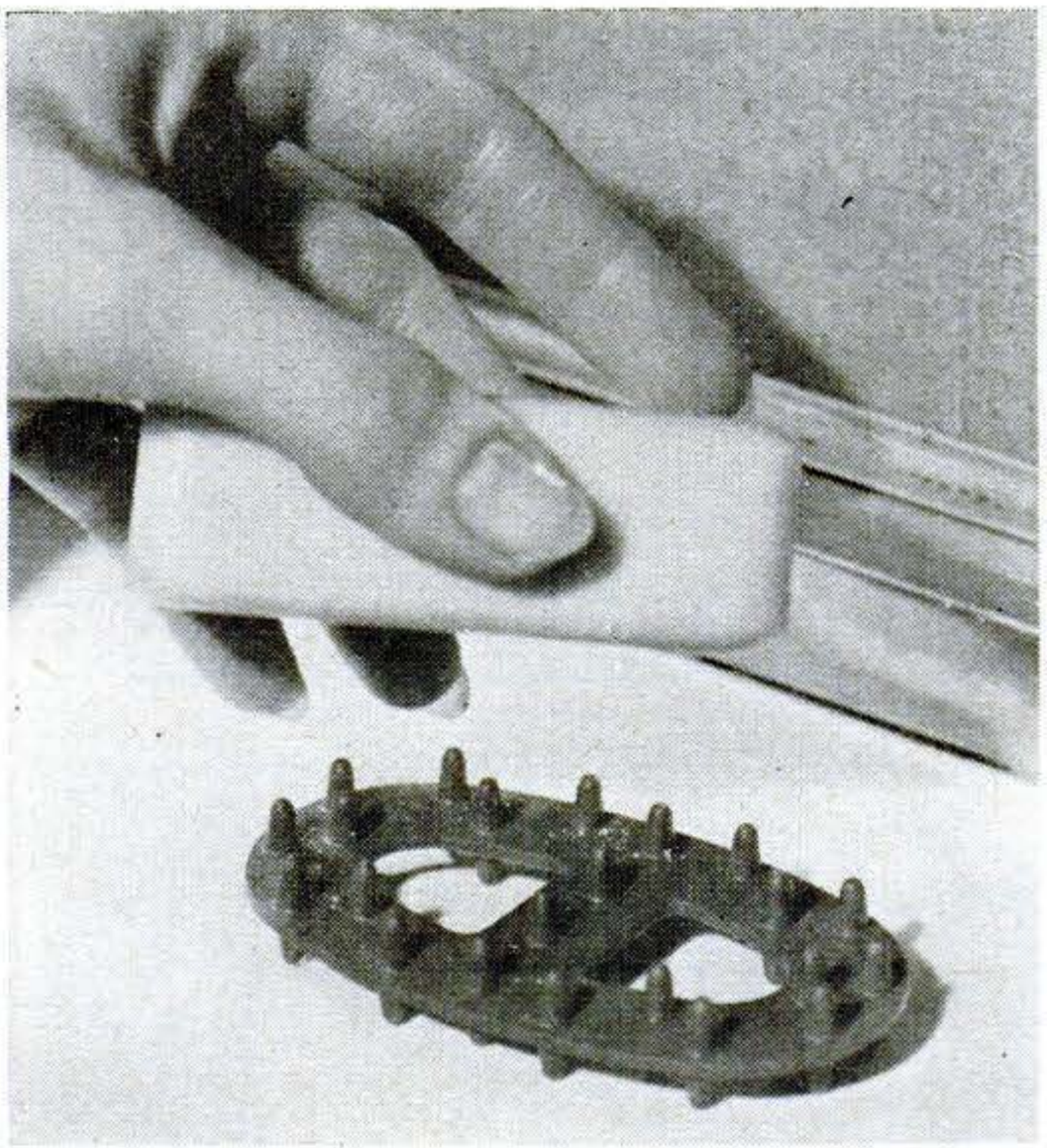

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Modern Living

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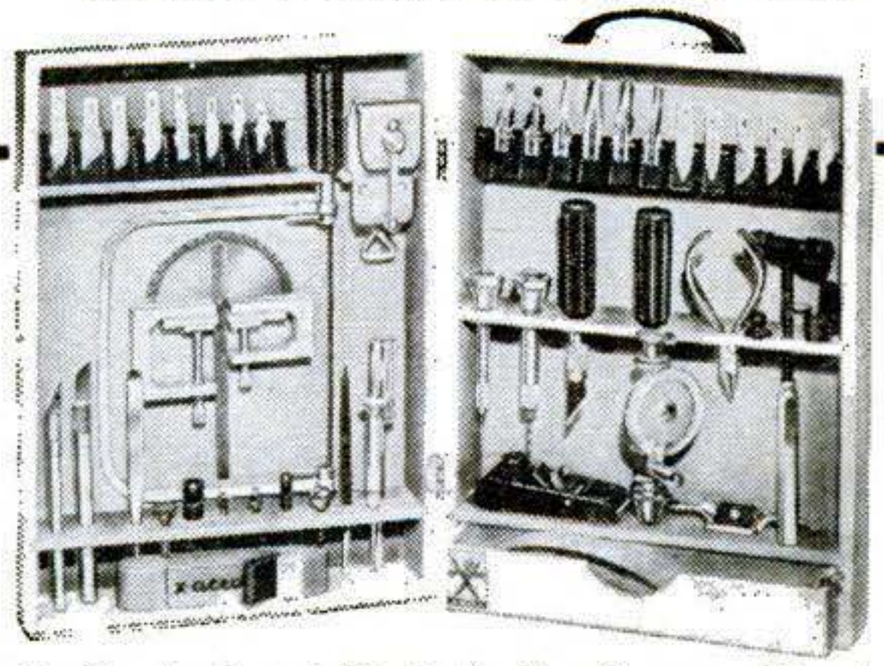
Complete set of X-acto Hobby Knives and Tools in portable wooden chest $25



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X-acto*

X-acto Crescent Prod. Co., Inc., 440—4th Ave., N.Y. 16
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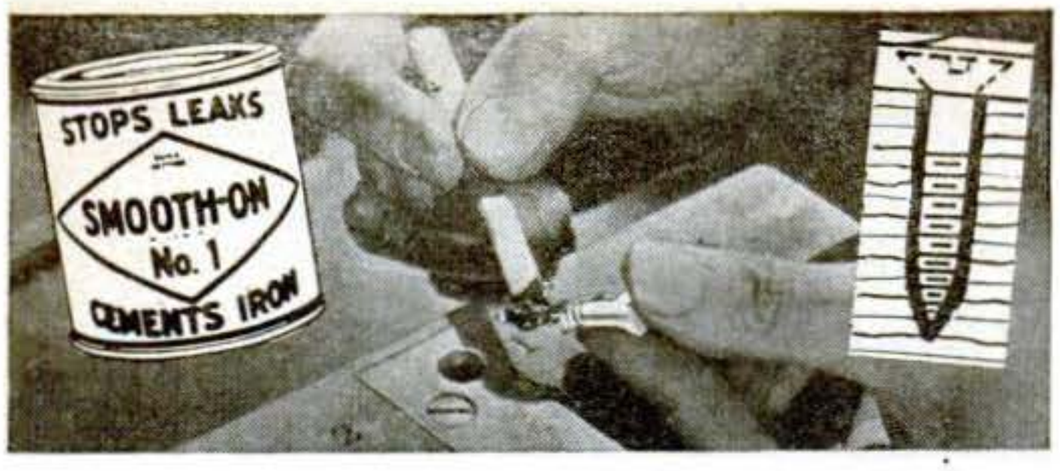

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Make 100% to 150% Profit!

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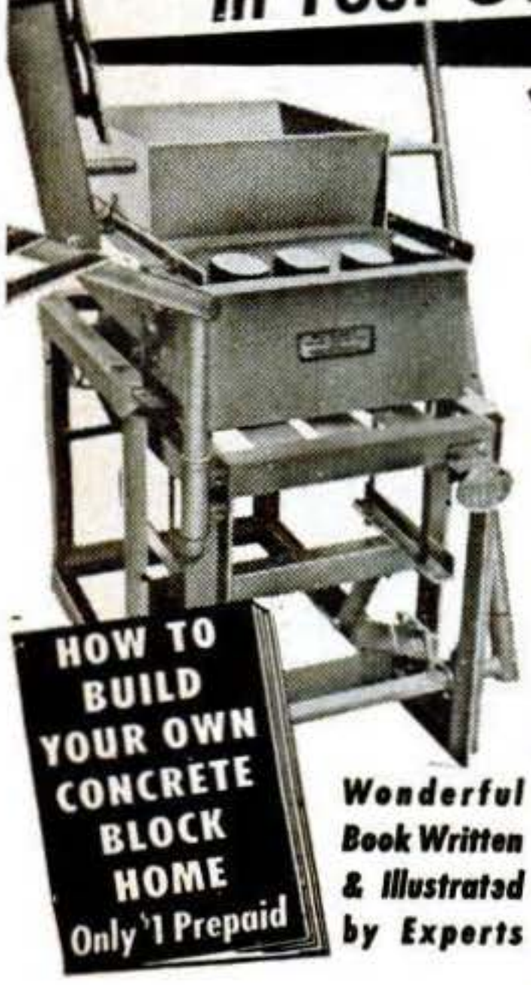

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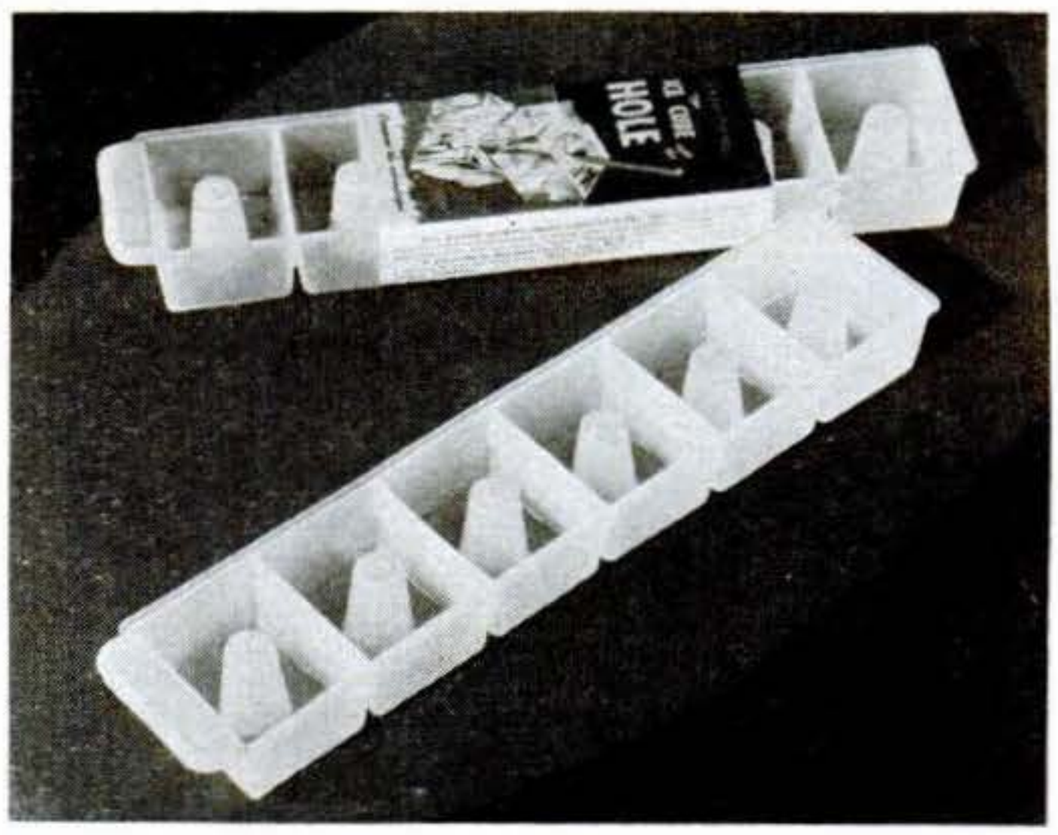
Includes floor plans for 6 beautiful, easy to build concrete block bungalows. Shows ways to save money. How to lay blocks, lay out building lines, mix concrete, build steps, porches and concrete floors. Mail coupon at once with $1.

Name.....
Address.....
City.....**Zone**...**State**....

Aids to Modern Living

Brush and Pan for Crumbs. The Silent Maid Crumber®, manufactured by Mastercraft Plastics Company, of Jamaica, N. Y., is a miniature dustpan and whisk broom molded of cellulose acetate. The maroon pan contrasts with the ivory-colored brush. A slot in the top of the dustpan takes the broom for convenient storage.



Ice Cubes with Holes. According to the maker of Lustro-Ware® ice-cube trays, Columbus Plastic Products, Inc., Columbus, O., ice cubes with holes are more than a novelty. They freeze quicker, cool drinks faster, and are easier to crush. One cube at a time, if desired, may be removed from the flexible plastic trays. The trays may also be used for dessert molds.

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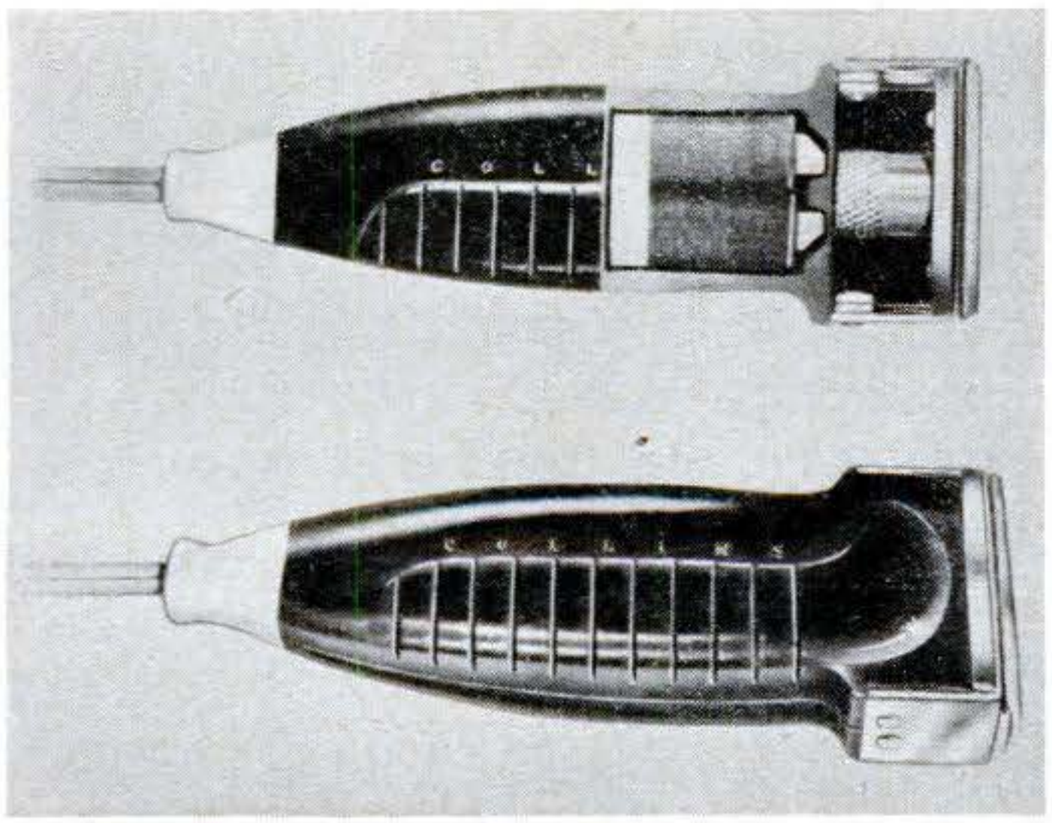
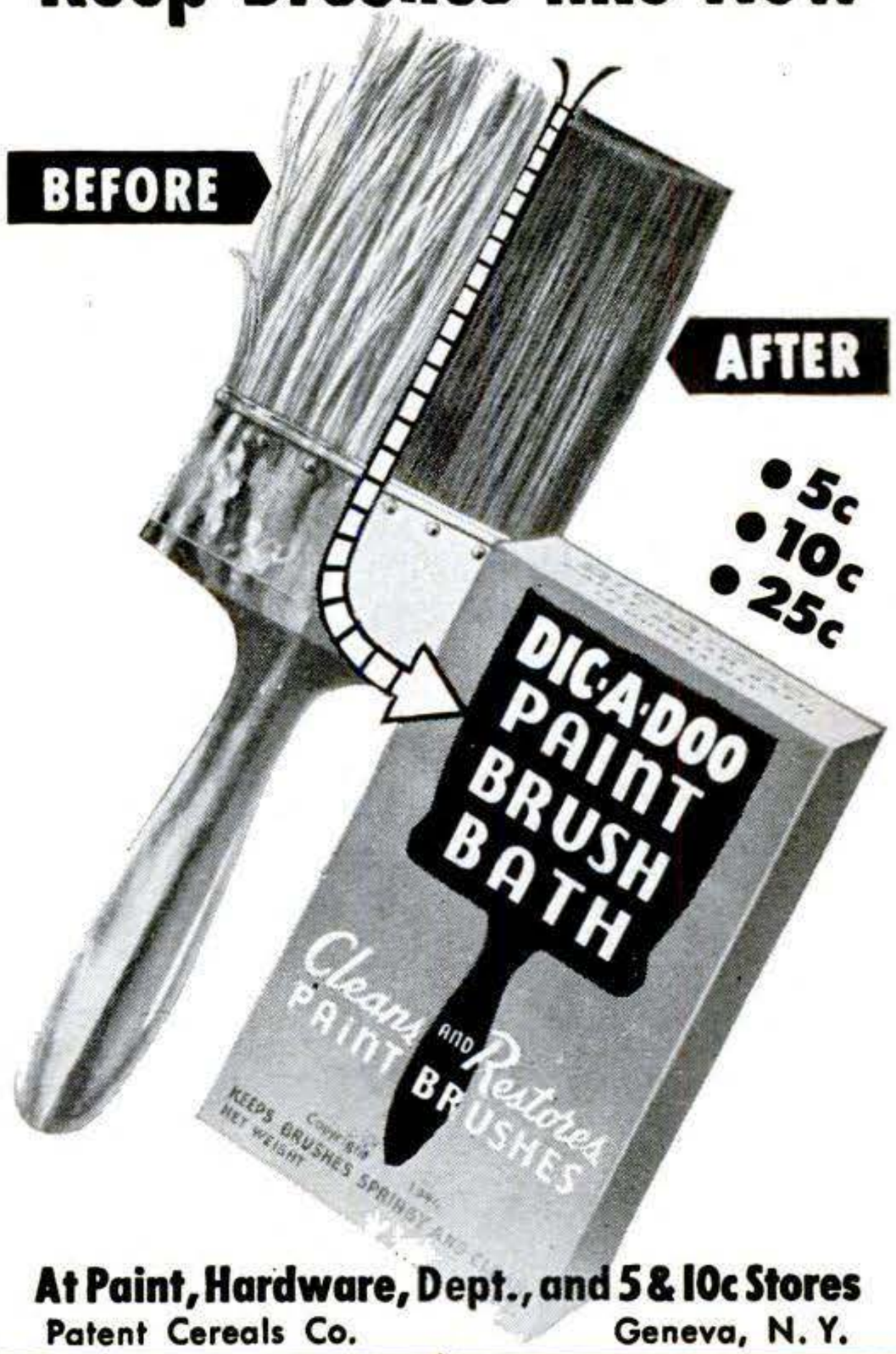
Electric Deep-Fat Fryer. There is only one control to set on the Fryryte®, and the heat of the fat is automatically controlled by a thermostat. The fryer holds three pounds of vegetable fat. Temperatures range from 350° to 400°, cooking food in from two to eight minutes. The maker is Dulane Mfg. Co., Joliet, Ill. About $25.



Wet Electric Shaver. The Vibrazor®, operating on 115 volts AC, uses a standard double-edged razor blade. It may be rinsed under the tap as you shave, for the electromagnetic drive is completely enclosed in a water-tight housing. The magnetic vibrations work it through the sealed plastic housing. It's priced at about $10 by New Electric Razor Corp., Baltimore.

Keep Brushes like New



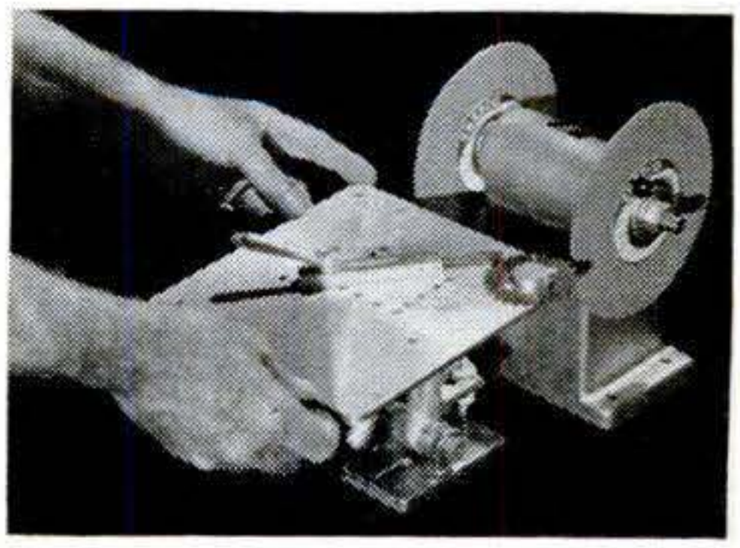
At Paint, Hardware, Dept., and 5 & 10c Stores

Patent Cereals Co. Geneva, N. Y.

New **To Sharpen Carbide Tip Tools, • All Types of Cutters and Circular Saws**

A PRECISION FIXTURE ➧ *Only* **$29.50**

This all-purpose sharpening fixture is the only one of its kind. Easiest, simplest, fastest sharpening method available. Assures cleaner cuts. Save money and make money by sharpening tools, cutters and saws for yourself and others. Precision built at surprisingly low prices. Send check or money order . . . money-back guarantee . . . nothing to lose . . . shipped prepaid.



Model 135 only **$29.50** for 1½" to 12" diameter saws and cutters. Table tilts either side over 30°.
Model 160 only **$49.50** for 1½" to 16" diameter saws and cutters. Table tilts either side over 30°.
Model 280 only **$11.95** for 7" to 8" diameter saws.
Model 100 only **$14.95** for 7" to 10" diameter saws.
Model 120 only **$16.95** for 7" to 12" diameter saws.
Model 130 only **$23.50** for 2" to 12" diameter saws.
2 grinding wheels **$5.00** extra.

TREYCO PRODUCTS

264 Hartford Avenue—Dept. P.S. 9—Buffalo 17, N. Y.

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Last minute news & notes...

CHEAP CAR rumors are rife again, but don't take them seriously. No big company plans even a stripped-down model, because: (1) glamour jobs sell better, (2) production has to be hitched to sales, (3) prices can be cut only peanuts-worth of raw steel, glass, rubber costs. As one motor mogul told PS scout, "A ring gear doesn't care whether it goes into a Chevvy or a Caddy."

KODAK'S NEW TOURIST Camera has a radically different shutter with a rotating rather than reciprocating action. Most between-lens shutters have top speed of 1/150 to 1/500; new Synchro-Rapid can snap at 1/800 second.

PLUMBERS would be smart to study up on atomics, say the PS editors who have been chinning with the nuclear physicists. More & more radioactive medical materials are going out to hospitals, and "hot" drains get clogged too. A Geiger counter may soon join the pipe-cutters and Stillsons in the tool box.

BENZEDRINE Inhalers, widely sniffed by hay-fever and head-cold sufferers, are being yanked off market by Smith, Kline & French Labs. Too many prison inmates and thrillkids opened them up to soak out active ingredient for quick lift. Makers tried adding red pepper, picric acid, other nauseating substances to stop misuse, but goofers who relished even paint and perfume were not bothered by bitters. So S.K.& F. developed completely new Benzedrex Inhalers, which shrink nasal membranes but offer no stimulation to misusers.

MODERNIZED: Sailors on the crack Atlantic liner Isle de France, recently restored to service, scrub the decks with an electric floor machine!

POKITOOL is the name of a new socket wrench and screwdriver kit designed to fit the pants as well as the nuts and screws - hex head, straight-slot, Phillips or Reed & Prince. Its 12 parts snap into 260 tool combinations. Made by Roberts Industries, Joliet, Ill.

NEW COLLEGE course in homemaking for men only is reported by McCall's Magazine. Studies include how machinery of living works--and how to fix it. P.S. readers need not apply.

QUOTE OF MONTH: Sumner Pike, Atomic Energy Commissioner, commenting on progress, "We were...in the position of a crew who started out with a 1941 car from New York with orders to drive to San Francisco at better than 60 m.p.h. and in the meantime convert it to a 1949 model."

The Editors

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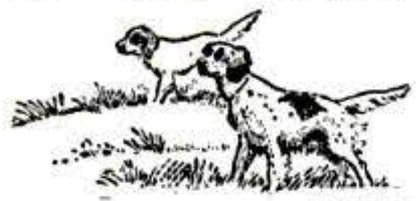
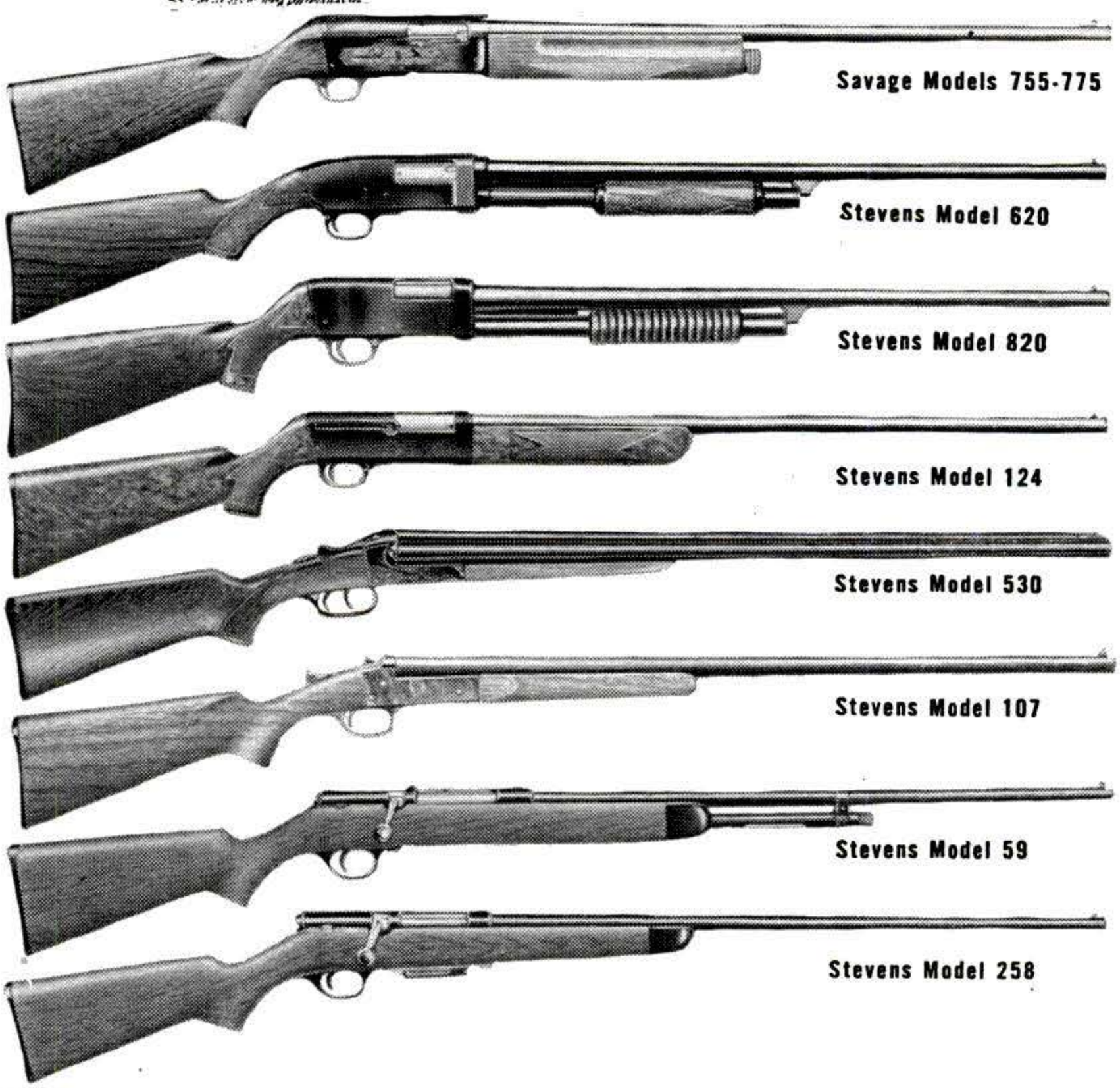
SHOTGUN VALUES



FIRST IN THE FIELD



Looks . . . Performance . . . Dependability at *lowest cost* make Savage-built shotguns *the* "first in the field" VALUES. Look over this wide range of models. Take your pick from sleekly streamlined auto-loaders (standard and lightweight models) . . . fast-handling "pump" guns . . . well balanced bolt action repeaters and dependable "singles" and "doubles". Then, choose the *kind* of gun for *your* kind of shooting at the price you want to pay. See these Values at your Dealer's — Write for Free Catalog.

Savage Arms Corporation • Firearms Division • Chicopee Falls, Mass.

STEVENS
PIONEERING BETTER GUNS AND GREATER VALUES SINCE 1864

SAVAGE
WORLD FAMOUS FOR DEPENDABILITY AND ACCURACY

"First in the Field" in VALUE

Savage Streamlined Automatics — Models 755 (standard for long range shooting with heavy loads); 775 (lightweight for upland game and skeet). 12 and 16 ga. — 3-5 shot. New, streamlined design. No changes in tested, service-proven functional design—changes affect exterior streamlining only —but trigger and hammer mechanisms have been improved.

Stevens Model 620 — Slide Action Repeating Shotgun. 12, 16, 20 gauge. 5-shot with one in magazine, making 6-shot repeater. Fast handling, smooth operating, dependable. Checkered walnut pistol grip; checkered slide handle.

Stevens Model 820 — Slide Action Repeating Shotgun. 12 gauge only. The newest Savage "first in the field" value. Sensationally low priced. Natural pointing, smooth operating. Stock and slide handle of Tenite.

Stevens Model 124 — Repeating Shotgun. 12 gauge only. Features a compactly efficient, simple to operate cross bolt action — a Savage pioneered design. A new value in the repeating shotgun field. Tenite stock and fore-end.

Stevens Model 530 — Double Barrel Shotgun. 12, 16, 20 and .410 gauges. Hammerless . . . coil springs . . . forged steel barrels. Checkered walnut stock and forearm, full pistol grip. Well balanced, natural pointing, dependable. (MODEL 311 DOUBLE — same as above but with stock and forearm of Tenite).

Stevens Model 107 — Single Barrel Shotgun. 12, 16, 20 and .410 gauges. Hammer style . . . automatic ejector . . takedown . . . case hardened frame. Walnut stock and forearm. (MODEL 94 SINGLE — same as above but with stock and forearm of Tenite).

Stevens Model 59 — Bolt Action, Tubular Magazine, 6-shot Repeater. .410 gauge. 2½ or 3 inch shells. One piece walnut finish stock with black tipped forearm. Lightweight, well balanced, attractively priced.

Stevens Model 258 — Bolt Action, Clip Magazine 3-shot Repeater — 20 gauge. 2 shells in clip, one in chamber. Walnut finish stock with black tipped forearm. Takedown. A fast handling, low priced model in a popular gauge.

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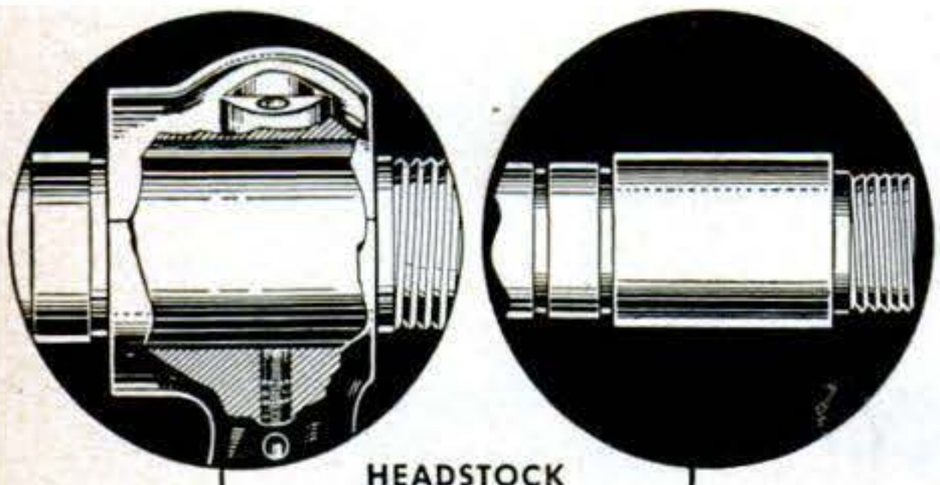
SOUTH BEND 9" LATHES



HEADSTOCK

Bearings are line bored and bearingized for precision fit. Ample lubrication from oil reservoirs. Spindle is carburized, hardened, and ground; with bearing surfaces super-finished to .000005" rms.

BELT RELEASE

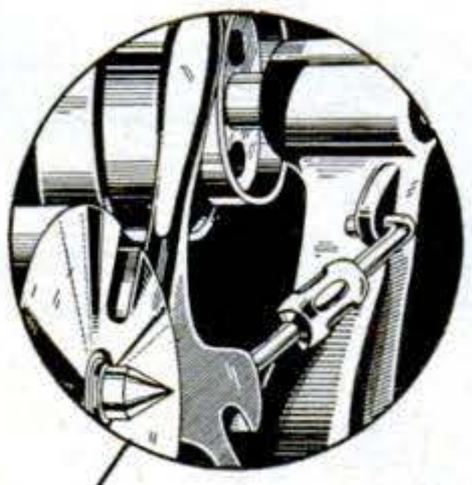
Instant release of belt tension for speed changes. Proper tension of headstock spindle drive belt is easily adjusted.

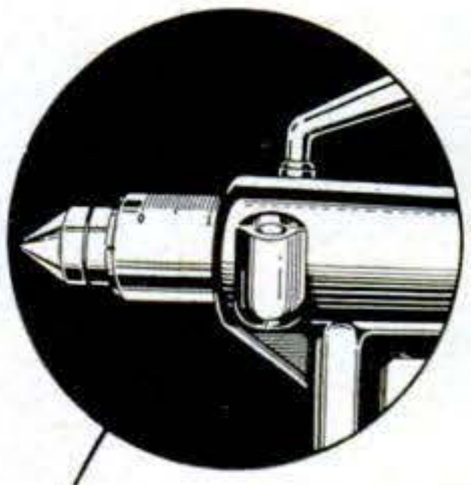
TAILSTOCK

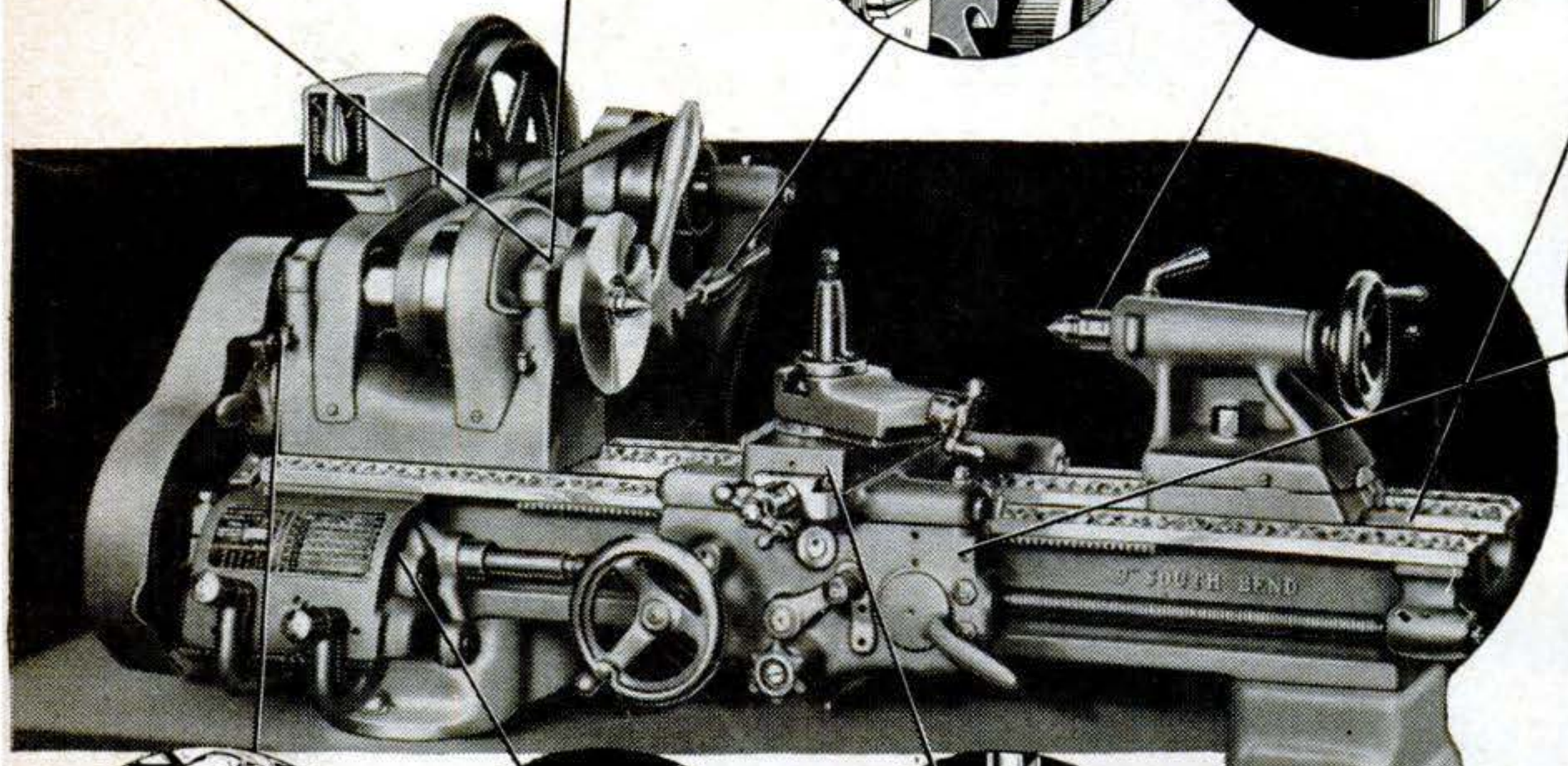
Has set-over for taper turning. Graduated spindle has witness mark for aligning cutter bit. Hardened center self-ejecting.

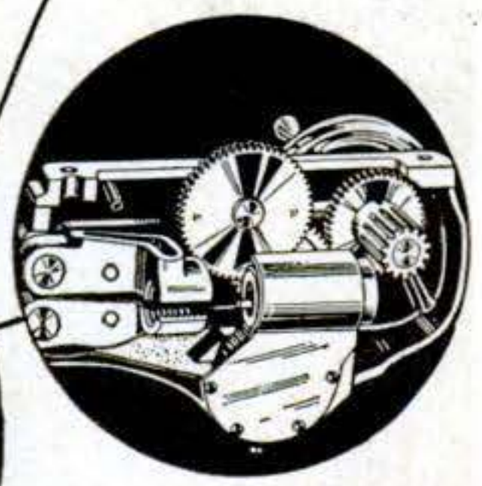
BED

Three V-ways and one flat-way are hand-scraped entire length for precision alignment of headstock, tailstock, and carriage.



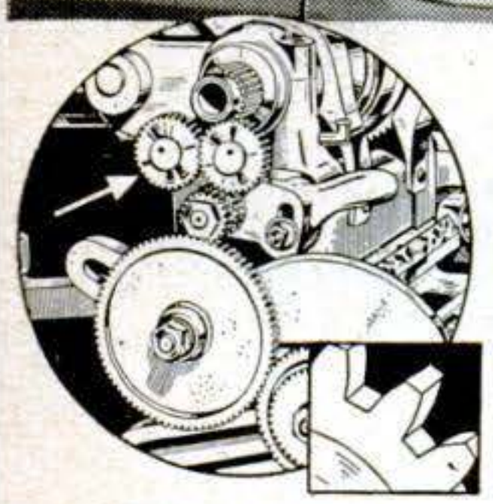






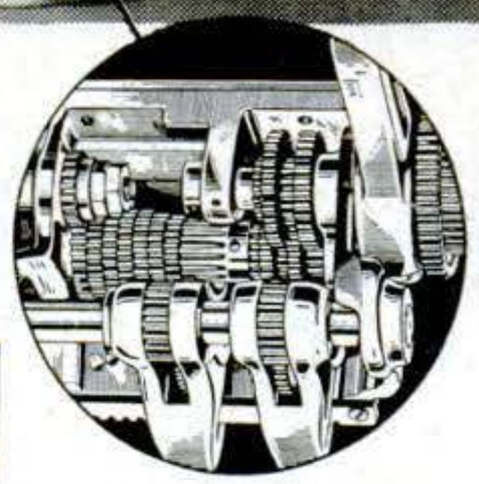
APRON

Has powerful friction clutch and large half-nuts. Safety interlock prevents engaging opposing feeds. All gears machine cut.



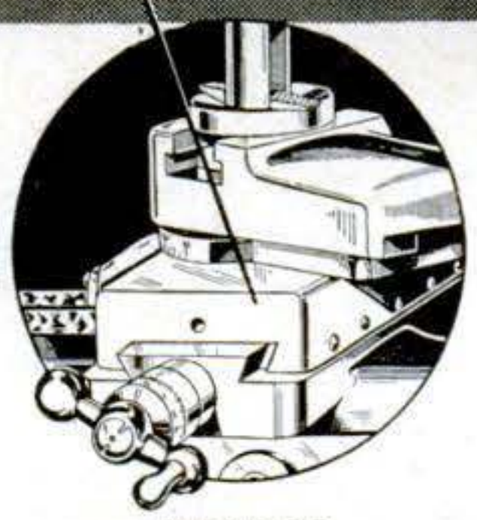
REVERSE GEARS

Easily shifted for reversing lead screw rotation and feeds, positive lock. All the gears used in this lathe are machine cut.



GEAR BOX

Screw threads and power feeds selected by shifting two tumblers as indicated on index chart. All gears machine cut steel.



CARRIAGE

V-ways and dovetails hand-scraped. Engine divided micrometer collars on feed screws. Compound Rest base graduated 180 degrees.

Specifications...

South Bend 9" Model A Lathe

SWING . . . . . over bed — 9-1/4"
over cross slide — 5"

BED LENGTHS . 3, 3-1/2, 4, and 4-1/2 feet

DISTANCE BETWEEN CENTERS . 16" to 34"

SPINDLE SPEEDS (12) . 41 to 1270 r.p.m.

POWER FEEDS:
Longitudinal (48) . . . . .0015" to .0853"
Cross-feed (48) . . . . . .0004" to .0252"

THREADS (48 pitches) . . 4 to 224 per inch

MAXIMUM COLLET CAPACITY. . . 1/2 inch

SPINDLE BORE . . . . . 3/4 inch

TAILSTOCK TOP SET-OVER . . . . 5/8 inch

9" x 3' Model A Bench Lathe, illustrated (Cat. No. 644-Y), with 12-speed horizontal drive, motor, and control — less bench . . **$340.45***

Time Payment Terms — $85.45 down, 12 monthly payments of $22.52.

Other models of South Bend 9" Lathes, priced from $187.35* to $805.45*, may also be purchased on time payment terms of 25% down with balance in 12 monthly payments, small finance charge.

*Prices, f.o.b. factory, include 1 phase, 60 cy., 115-V. motor and control.

SOUTH BEND LATHE WORKS

456 East Madison Street, South Bend 22, Indiana, U.S.A.

Please send catalog(s) checked:

- ☐ Catalog No. 9 — all models of South Bend 9" Lathes.
- ☐ Catalog No. 100 — all sizes of South Bend Lathes.
- ☐ Catalog No. 400 — South Bend Precision Drill Presses.
- ☐ Catalog No. 500 — 7" Bench Shaper.
- ☐ Catalog No. 77 — Attachments and Accessories.
- ☐ Time Payment Plan.

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SOUTH BEND LATHE WORKS

BUILDING BETTER TOOLS SINCE 1906

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